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AERONAUTICAL ENGINEERING

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Supplement 67

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NASA SP-7037 (67)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 67

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in January 1976 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*

Scientific and Technical Information Office FEBRUARY 1976
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 341 reports, journal articles, and other documents originally announced in January 1976 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles

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N76-11046*# Georgia Inst of Tech Atlanta
STUDY OF VISCOUS FLOW ABOUT AIRFOILS BY THE INTEGRO-DIFFERENTIAL METHOD Final Report
James C Wu and Sarangan Sampath Oct 1975 61 p refs
(Grant NsG-1004)
(NASA-CR-145693) Avail NTIS HC $4 50 CSCL 01A

An integro-differential method was used for numerically solving unsteady incompressible viscous flow problems A computer program was prepared to solve the problem of an impulsively started 9% thick symmetric Joukowski airfoil at an angle of attack of 15 deg and a Reynolds number of 1000 Some of the results obtained for this problem were discussed and compared with related work completed previously Two numerical procedures were used an Alternating Direction Implicit (ADI) method and a Successive Line Relaxation (SLR) method Generally the ADI solution agrees well with the SLR solution and with previous results are stations away from the trailing edge At the trailing edge station the ADI solution differs substantially from previous results while the vorticity profiles obtained from the SLR method there are in good qualitative agreement with previous results Y J A

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A76-10264 * # **Hybrid upper surface blown flap propulsive-lift concept for the Quiet Short Haul Research Aircraft** J A Cochrane and R J Carros (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75 1220* 9 p 5 refs

The hybrid upper surface blowing concept consists of wing mounted turbofan engines with a major portion of the fan exhaust directed over the wing upper surface to provide high levels of propulsive lift, but with a portion of the fan airflow directed over selected portions of the airframe to provide boundary layer control NASA sponsored preliminary design studies identified the hybrid upper surface blowing concept as the best propulsive lift concept to be applied to the Quiet Snort Haul Research Aircraft (QSRA) that is planned as a flight facility to conduct flight research at low noise levels high approach lift coefficients, and steep approaches Data from NASA in house and NASA sponsored small and large scale wind tunnel tests of various configurations using this concept are presented (Author)

AERONAUTICAL ENGINEERING

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IAA ENTRIES

A76-10091 **NOISEXPO '75; National Noise and Vibration Control Conference, 3rd, Atlanta, Ga, April 30-May 2, 1975, Proceedings of the Technical Program** Edited by J K Mowry Bay Village, Ohio, NOISEXPO, 1975 358 p $20

Papers are presented dealing with problems in environmental noise legislation, industrial noise control, community noise programs, and air and surface transportation noise Some of the topics covered include computer technique for in-plant noise control, a new analog/digital sound level meter, the economics of a meaningful environmental noise impact study, adhesives and sealants for sound control materials, reports of sleep interference and annoyance by aircraft noise, and community involvement in power plant noise abatement

P T H

A76-10092 **Application of the AICUZ concept to NAS Oceana, Virginia Beach, Virginia** B Martin (Robert and Company Associates, Atlanta, Ga) In NOISEXPO '75, National Noise and Vibration Control Conference, 3rd, Atlanta, Ga, April 30-May 2, 1975, Proceedings of the Technical Program Bay Village, Ohio, NOISEXPO, 1975, p 233-239

The paper describes a noise impact study conducted at the Naval Air Station (NAS) Oceana, Virginia, where the problem of the confrontation of civilian and military interest groups was to be met by careful planning and zoning Noise ratings, noise complaints, and land use patterns were studied in order to develop a strategy of compatible growth on the part of both the military facility and surrounding resort area P T H

A76-10094 **Community noise caused by small aircraft and noise of small aircraft in takeoff configuration.** A J Campanella (ACCULAB, Columbus, Ohio). In NOISEXPO '75, National Noise and Vibration Control Conference, 3rd, Atlanta, Ga, April 30-May 2, 1975, Proceedings of the Technical Program
Bay Village, Ohio, NOISEXPO, 1975, p 330-334 9 refs

A case study of the clash of an expanding community and the airport is described on the example of a typical growing small community airport From a complaint study a good criterion for a model quiet light aircraft was derived - it should not produce more than 63 dBA SPL at ground level when flying over at an altitude of 500 ft Three quieting procedures were studied modified operational procedures, engine exhaust silencing, and propeller redesign plus engine gearing It is found that propeller noise, the dominant portion of the total noise, can be reduced by using lower tip speeds, typically achieved by a slower turning, larger diameter propeller. P.T.H.

A76-10095 * **Interior noise levels of two propeller driven light aircraft.** J J Catherines and W H Mayes (NASA, Langley Research Center, Hampton, Va) In NOISEXPO '75, National Noise and Vibration Control Conference, 3rd, Atlanta, Ga, April 30-May 2, 1975, Proceedings of the Technical Program
Bay Village, Ohio, NOISEXPO, 1975, p 335-338 9 refs

A test program is described with the objective of determining the relationship between aircraft operating conditions and interior noise and of determining the degree to which ground testing can be used in lieu of flight testing for performing interior noise research Measurements are presented for single and twin engine aircraft for 2 or 4 passengers It was found that noise levels are strongly influenced by the rotational speed of the engine and propeller Both the overall noise and low frequency spectra levels were observed to decrease with increasing high speed rpm operation during flight Comparison of spectra obtained in flight with spectra obtained on the ground suggests that identification of frequency components and relative amplitude of propeller and engine noise sources may be evaluated on stationary aircraft P T H

A76-10096 **Reports of sleep interference and annoyance by aircraft noise.** P N Borsky (Columbia University, New York, N Y) In NOISEXPO '75, National Noise and Vibration Control Conference, 3rd, Atlanta, Ga, April 30-May 2, 1975, Proceedings of the Technical Program Bay Village, Ohio, NOISEXPO, 1975, p 339-343

The paper presents the results of a community noise survey in which 1500 residents living in 11 communities near Kennedy Airport in New York were interviewed with regard to their night, day and evening annoyance responses to aircraft noise It was found that, while nighttime operations are only 35% of evening or 48% of daytime activity, the reported mean annoyance during the night is 71% of evening and 90% of the daytime reported annoyance This suggests that each nighttime flight has the equivalent annoyance effect of 2 day or evening flights This is compared with the CNR, NEF and Ldn indexes that assume that 10 daytime flights are the equivalent of one nighttime flyover P T H

A76-10097 **Comparative noise and structural vibration levels from Concorde and subsonic aircraft.** J E Wesler (U S Department of Transportation, Office of Noise Abatement, Washington, D C) In NOISEXPO '75, National Noise and Vibration Control Conference, 3rd, Atlanta, Ga, April 30-May 2, 1975, Proceedings of the Technical Program Bay Village, Ohio, NOISEXPO, 1975, p 344-350

The paper discusses the potential noise problem around airports which handle SSTs on a routine basis Some recent measurements are described to compare the noise characteristics of the Concorde with conventional four-engine subsonic transport aircraft Earlier results were confirmed that Concorde noise characteristics are different from those of subsonic conventional aircraft, containing relatively greater low frequency acoustic energy and inducing relatively higher levels of structural vibration in nearby buildings Concorde noise levels are equivalent to those of contemporary subsonic long-range aircraft, at least under the approach path Noise levels near the takeoff path are significantly higher, at least until the afterburner is cut off P T H

A76-10155 # **Technological progress in aircraft construction (Tekhnicheskii progress v samoletostroenii)** V A Stepanchenko, V P Rossikhin, B L Smolenskii, V I Kliment'ev, M A Rokhlenko, and B A Medvedev Moscow, Izdatel'stvo Mashinostroenie, 1975 360 p 47 refs In Russian

The book examines selected areas in which aircraft construction has been advanced through the use of new technology and production processes Experience in the implementation of automatic control systems for production control and planning is summarized Other topics examined include mechanization of making rivetted and bolted joints, impact methods of shaping parts, and the use of low temperatures in the treatment and testing of structural elements and parts Equipment and procedures for full scale low-temperature tests simulating flight conditions are described Surface finishing methods for increased strength and resistance of parts are examined along with new equipment for vibro-abrasive finishing, vibro-impact finishing, diamond smoothing, and hydro-abrasive finishing P T H

A76-10241 # **Discrete components in ejector noise and techniques for suppressing them (Diskretnye sostavliaiushchie v shume ezkektora i metody ikh podavleniia)** P G Kolev In Acousto-aerodynamic studies Moscow, Izdatel'stvo Nauka, 1975, p 18-25 11 refs In Russian

It is noted that discrete components arising during the operation of an ejector with a supercritical pressure drop completely determine the integral noise level and can attain significant magnitudes A mathematical model is formulated which indicates that additional modulation of the surface of the jet in the ejector will result in suppression of the discrete components and a reduction in the integral noise level during ejector operation Experimental verification of the model is presented F G M

A76-10242 # **Acoustic pressure field of vortex sound near rotating blades (Pole akusticheskikh davlenii vikhrevogo zvuka vblizi vrashchaiushchikhsia lopastei)** L A Bazhenova In Acousto-aerodynamic studies Moscow, Izdatel'stvo Nauka, 1975, p 29-35 In Russian

Results are reported for calculations of the pressure field near rotating blades due to the wideband portion of the noise radiated by the blades (vortex noise) Regions of maximum and minimum intensity of vortex noise near a blade are located, and it is shown that the maximum contribution to the noise intensity is made by blade elements located at a distance corresponding to 0 8 times the total radius of the blade Good agreement is found with experimental measurements F G M

A76-10243 # **Influence of the turbulence of the flow incident on a body on the intensity of vortex sound emission (Vliianie turbulentnosti nabegaiushchego na telo potoka na intensivnost' izlucheniia vikhrevogo zvuka)** D V Bazhenov, L A Bazhenova, and A V Rimskii-Korsakov In Acousto aerodynamic studies Moscow, Izdatel'stvo Nauka, 1975, p 35-41 In Russian

A76-10244 # **Vortex noise of rotating machinery (O vikhrevom zvuke lopatochnykh mashin)** D V Bazhenov and A V Rimskii-Korsakov In Acousto-aerodynamic studies Moscow, Izdatel'stvo Nauka, 1975, p 41-45 15 refs In Russian

The composition of noise produced by rotating machinery (fans, compressors) is briefly described Ways to reduce discrete components of noise are enumerated, and the wideband noise component is examined both theoretically and experimentally It is shown that increasing the length or width of the blades can reduce the noisiness of a machine with rated aerodynamic output It is also shown that resonances of the machine housing, when interacting with the wideband noise, can result in an anomalously high noise level and that turbulence of an incoming flow due to air intake can also increase machine noise F G M

A76-10248 # **Blade-wheel noise caused by random inhomogeneities of an incoming flow (Shum lopatochnogo kolesa, vyzyvaemyi sluchainymi neodnorodnostiami nabegaiushchego potoka)** A. V Rimskii-Korsakov In Acousto-aerodynamic studies Moscow, Izdatel'stvo Nauka, 1975, p 72-77 7 refs In Russian

The noise spectrum is evaluated which arises from the interaction of the blades in an axial-flow fan with random inhomogeneities (velocity fluctuations) of the incoming flow It is shown that a series of maxima are located in this spectrum near the frequencies that are multiples of the rotation frequency of the blade wheel and that the bandwidth of these maxima depends on the rotation time and the dimensions of the inhomogeneities in comparison with the rotation period and the blade dimensions The maximum estimate gives 110 dB of sound pressure at a distance of 10 meters for a 100-kW fan with 20 blades rotating at 3000 rpm and a 2% effective fluctuation of flow velocity F G M

A76-10250 # **Investigation of the acoustic characteristics of a supersonic jet flowing into a cylindrical tube (Issledovanie akusticheskikh kharakteristik sverkhzvukovoi strui, vytekaiushchei v tsilindricheskuiu trubu)** Iu A Borisov, N M Gynkina, S A Vinogradov, L S Pykhov, and B I Fedorov In Acousto-aerodynamic studies Moscow, Izdatel'stvo Nauka, 1975, p 91-97 In Russian

A76-10251 # **Development of an integrated propulsion control system** G W N Lampard (Boeing Aerospace Co, Seattle, Wash) and J J Batka (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1178* 15 p

The operational capability of aircraft can be expanded by integrated propulsion controls The benefits are summarized in Table I Steady-state engine performance (thrust, SFC) can be improved by operating closer to the engine limits External disturbances can be tolerated by shifting the engine operating point for the duration of the disturbance Faster, smoother transients can be accomplished by retreating from the operating limits (sacrificing fuel economy or peak thrust momentarily) during accels and decels Engine life and time between overhauls can be extended by more consistent avoidance of momentary over-temperature and over-stress conditions and by minimizing temperature cycling Crew work load may be reduced through a greater degree of automation While these performance improvements are applicable to both military and civilian aircraft, implementation of them has been impeded by the inherent limitations of hydromechanical controls and by the fact that the newer, more complex propulsion systems are more difficult to control (Author)

A76-10252 * # **Status of a digital integrated propulsion/flight control system for the YF-12 airplane** P J Reukauf, F W Burcham, Jr, and J K Holzman (NASA, Flight Research Center, Edwards, Calif) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1180* 9 p 6 refs

The NASA Flight Research Center is engaged in a program with the YF-12 airplane to study the control of interactions between the airplane and the propulsion system The existing analog air data computer, autothrottle, autopilot, and inlet control system are to be converted to digital systems by using a general purpose airborne computer and interface unit First, the existing control laws will be programmed in the digital computer and flight tested Then new control laws are to be derived from a dynamic propulsion model and a total force and moment aerodynamic model to integrate the systems These control laws are to be verified in a real time simulation and flight tested (Author)

A76-10253 # **Effect of forebody shape and shielding technique on 2-D supersonic inlet performance** L E Surber (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1183* 20 p 8 refs

Diagnostic data from large-scale airframe-inlet model wind tunnel tests have been analyzed to facilitate understanding of 2-D inlet installations in highly maneuverable supersonic aircraft Inlet performance levels associated with various forebody shapes and integration techniques (side-mounted, wing-shielded, and fuselage-shielded) are compared to assess airframe interference effects Examinations of upstream airframe flow fields together with total pressure surveys through the duct and at the compressor face are used to explain trends of total pressure recovery, duct turbulence and compressor face steady-state and dynamic flow distortion index over a wide range of flight maneuver conditions (Author)

A76-10257 # **Economic benefits of engine technology to commercial airline operators** J R Morello (General Electric Co, Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1205* 10 p

New technology commercial turbofan engines, characterized by high bypass ratios, entered airline service in 1970 Their productivity is considerably better which results in the high-bypass powered aircraft being superior to earlier aircraft in terms of available seat miles/operating dollars Further, engine testing technology has advanced such that the number of new problems discovered in service can be significantly reduced thereby cutting maintenance costs This paper discusses the productivity advantages of high-bypass engines, and the testing concepts used by General Electric in development of the CF6 engine family that has led to improvements in initial reliability and maturity compared to low-bypass engines (Author)

A76-10258 # **Performance evaluation methods for the high-bypass-ratio turbofan** C R Bartlett and E E Turner (ARO, Inc, Arnold Engineering Development Center, Arnold Air Force Station, Tenn) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1206* 9 p 7 refs

The basic performance testing techniques employed by the Engine Test Facility at the Arnold Engineering Development Center are reviewed The unique problems associated with the low specific thrust and the low nozzle pressure ratios (often unchoked) of the high-bypass-ratio engine are discussed The sensitivities of these engines, particularly at low flight speeds, to set conditions, such as ram pressure ratio, are explored and techniques for minimizing measurement uncertainty and optimizing performance data accuracy are developed Alternate thrust calculation processes (measured scale force, momentum balance, and nozzle coefficients) are shown to be a vital tool in optimizing the performance evaluation The effect of component interaction, specifically the fan operating point on fan nozzle velocity coefficients, is shown to have significant effect on high-bypass-turbofan nozzle performance (Author)

A76-10259 * # **An early glimpse at long-term subsonic commercial turbofan technology requirements** D E Gray (United Technologies Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) and J F Dugan (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1207* 7 p Contract No NAS3-19132

This paper reports on the exploratory investigation and initial findings of the study of future turbofan concepts to conserve fuel To date, these studies have indicated a potential reduction in cruise thrust specific fuel consumption in 1990 turbofans of approximately 15% relative to present day new engines through advances in internal aerodynamics, structure-mechanics, and materials Advanced materials also offer the potential for fuel savings through engine weight reduction Further studies are required to balance fuel consumption reduction with sound airlines operational economics (Author)

A76-10260 # **The Prop-Fan - A new look in propulsors** C Rohrbach and F B Metzger (United Technologies Corp, Hamilton Standard Div, Windsor Locks, Conn) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1208* 11 p 14 refs

The performance and noise aspects of a new propulsor, the Prop-Fan, are discussed The Prop-Fan is a small diameter, highly loaded, multi bladed, variable pitch unducted propulsor Its blades incorporate thin, advanced airfoil sections with tip sweep and are integrated with a spinner/nacelle shaped to reduce axial Mach number through the blading An extensive discussion based on propeller performance testing and analysis is presented to show that the Prop-Fan has the potential for providing significant fuel savings and better aircraft climb performance Exterior noise during takeoff and landing is shown to be less than that of the new wide body transports Interior noise is shown to be equal to that of the current turbofan transports (Author)

A76-10262 * # **Internal flow calculations for axisymmetric supersonic inlets at angle of attack** L L Presley (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1214* 7 p 11 refs

Several solutions for the internal flow in axisymmetric supersonic inlets at angle of attack were obtained A shock-capturing finite-difference technique was used to obtain the solutions Good overall agreement between the shock capturing solutions and experimental data was obtained, except in regions of strong viscous effects or boundary layer removal The required centerbody translation with changes in freestream Mach number and angle of attack was obtained and agrees qualitatively with experimental data (Author)

A76-10263 # **The development of theoretical models for jet-induced effects on V/STOL aircraft** M J Siclari, D Migdal (Grumman Aerospace Corp, Bethpage, N Y), and J L Palcza (U S Naval Air Propulsion Test Center, Trenton, N J) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1216* 11 p 12 refs Contract No N00140-74-C-0113

Successful design and development of V/STOL aircraft requires an understanding and accurate prediction of aircraft forces and moments caused by jet induced phenomena Several computerized analytic procedures have been developed using potential flow theoretical solutions to model the entrainment and displacement effects of a propulsion system efflux The various flow regimes and theoretical models will be described for out-of-ground effect and in-ground effect, where multi jet interactions with the ground plane cause significantly increased entrainment and fountain forces These jet models are coupled with a panel method for calculating the aerodynamic forces and moments Excellent agreement between calculated and model test data is displayed (Author)

A76-10264 * # **Hybrid upper surface blown flap propulsive-lift concept for the Quiet Short-Haul Research Aircraft** J A Cochrane and R J Carros (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1220* 9 p 5 refs

The hybrid upper surface blowing concept consists of wing-mounted turbofan engines with a major portion of the fan exhaust directed over the wing upper surface to provide high levels of propulsive lift, but with a portion of the fan airflow directed over selected portions of the airframe to provide boundary layer control NASA-sponsored preliminary design studies identified the hybrid upper surface blowing concept as the best propulsive lift concept to be applied to the Quiet Short-Haul Research Aircraft (QSRA) that is planned as a flight facility to conduct flight research at low noise levels, high approach lift coefficients, and steep approaches Data from NASA in-house and NASA-sponsored small and large-scale wind tunnel tests of various configurations using this concept are presented (Author)

A76-10279 # **Engine life cycle cost considerations during the validation phase** J D S Gibson, D E Collins, and C A Conley (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif , Sept 29-Oct 1, 1975, AIAA Paper 75-1289* 11 p

The current status of aircraft engine life cycle cost methods in the context of Department of Defense development and acquisition programs is reviewed Important validation phase life cycle costing activities are discussed, and some cost prediction and model development programs are outlined Related government industry interface activities in the validation phase are discussed B J

A76-10280 # **Application of new development concepts to F101 engine for B-1 aircraft** G H Ward (General Electric Co , Evendale, Ohio), L L Christensen (Rockwell International Corp , Los Angeles, Calif), and R J Sayles (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif , Sept 29-Oct 1, 1975, AIAA Paper 75-1290* 7 p

This paper describes the application of new development concepts to the F101 engine program The F101 augmented turbofan engine is being developed by General Electric for the Air Force B-1 supersonic bomber This development, initiated in 1970, had progressed through completion of PFRT when the new development concepts were applied Outlined in this report are the steps taken to modify the F101 development program to the degree possible to comply with the new concepts Since the F101 Program already contained many of the new concepts - multiple milestones, nonconcurrent development and production, etc - the changes incorporated were principally in the areas of mission related testing and post qualification development (Author)

A76-10281 # **Comparison of testing techniques for isolated axisymmetric exhaust nozzles in transonic flow** J A Laughrey (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif , Sept 29-Oct 1, 1975, AIAA Paper 75-1292* 12 p 9 refs

Axisymmetric exhaust nozzles with geometrically similar external and internal shapes were tested in several wind tunnel facilities in the United States and in Europe The results presented concentrate on the flow over a nozzle with a 15 deg mean chord angle boattail tested in the 0 8 to 0 95 Mach number range Limited results are given for nozzles that had boattail angles of 10 deg and 25 deg Differences in model support, model scale, tunnel blockage, tunnel bouyancy, wall type and porosity, and tunnel reference flow conditions are examined in an attempt to understand the disagreement in the data An indication of possible wall interference is obtained by comparing the measured wall static pressure distributions to those determined analytically with a far field boundary condition corresponding to free flight conditions The results indicate that it is very important to accurately determine the tunnel reference conditions (Mach number and pressure) when comparing data from one facility to another (Author)

A76-10282 # **Reynolds number effect on nozzle/afterbody throttle-dependent pressure forces** A E Fanning and R J Glidewell (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif , Sept 29-Oct 1, 1975, AIAA Paper 75-1295* 11 p 10 refs

A 0 10 scale, jet effects-model of the YF-17 was tested in a wind tunnel at approximately 0 9 Mach number, using the Reynolds number as a fundamental scaling parameter The effect of boundary layer transition grit is discussed It is shown that the aerodynamic effects are due to two interrelated phenomena (1) the throttle-dependent changes in the interaction of the propulsive jet with the basic nozzle/afterbody flow field, and (2) the throttle-dependent changes in the basic nozzle/afterbody flow field which interacts with the propulsive jet B J

A76-10284 # **Time dependent fuel injectors** H Viets, D Balster, and H L Toms, Jr (USAF, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif , Sept 29-Oct 1, 1975, AIAA Paper 75-1305* 9 p 8 refs

The present paper proposes a fluidically controlled nozzle which produces a time dependent flow at its exit The unsteadiness of the flow allows a more intimate mixing between the fuel and oxidizer and therefore offers the potential for a reduction of mixing chamber length and/or an improvement in combustion efficiency The nozzle may be used for either single phase flow (gas into a gaseous environment) or two phase flow (liquid into a gaseous environment) The fact that the nozzle is fluidically controlled eliminates the requirement for moving parts and thereby increases its reliability, especially in a high temperature combustion environment (Author)

A76-10285 # **The F101-GE-100 engine structural design** R C Hawkins and T L Hampton (General Electric Co , Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif , Sept 29-Oct 1, 1975, AIAA Paper 75-1308* 13 p

This paper outlines the key design requirements for the F101 engine of a supersonic bomber and a description of the unique structural characteristics of the engine Several computerized struc tural analysis methods used in the design are presented, emphasizing that the validity of the resulting predictions is dependent upon the compatibility of the boundary conditions with the details of a sound conceptual design Life analysis methods to establish component conformances to the mission-oriented cyclic life requirements and

A76-10286 # **Propulsion system and airframe structural integration analysis** M N Aarnes and J L White (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif , Sept 29-Oct 1, 1975, AIAA Paper 75-1310* 7 p 6 refs

A systematic procedure for structural integrity analysis of the propulsion system installation including airframe related structure is presented The approach to integration analysis is based on general purpose structural analysis programs utilizing substructuring The respective roles of the engine and the airframe companies in a cooperative effort are outlined, including math modeling and data exchange Technology needs are discussed along with the importance of timing in the integration process Preliminary results of normal mode vibration analysis of the total propulsion system are correlated with simpler analyses and with test stand data Emphasis is placed on propulsion system flight loads A methodology is suggested for determining the influence of operational flight loads on engine tip clearance and resulting performance deterioration (Author)

A76-10287 # **A three-dimensional approach to the optimization of a gas turbine disc and blade attachment.** R G Alderson, M. A Tani, R J Hill (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz), and D J Tree (USAF Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1312* 14 p 11 refs Contract No F33615-74-C-2012

A new three-dimensional finite-element stress simulation is described and applied to design optimization of a turbine disc/blade attachment. Isoparametric elements are employed, with the standard elements being a general parabolic conoid and a variable-thickness triangle The stress field obtained is improved with the use of a conjugate approximation A parametric study is used to select optimum attachment geometry The analysis model includes complex airfoil geometry and a non-zero broach angle (Author)

A76-10288 # **Investigation of non-symmetric two-dimensional nozzles installed in twin-engine tactical aircraft** T A Sedgwick (Lockheed-California Co , Burbank, Calif) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept. 29-Oct 1, 1975, AIAA Paper 75-1319* 42 p 12 refs Contract No F33615-74-C-3051

Potential applications of augmented deflector exhaust nozzles in twin-engine tactical aircraft were evaluated by means of analyses and preliminary design studies Three nozzle installations were compared with a datum aircraft convergent-divergent nozzle installation aspect ratio 4 vectored thrust nozzle and aspect ratios 6 and 17 supercirculation nozzles integrated with the wings Non-axisymmetric nozzles yield substantial improvements in maneuver load factor where buffet-limited lift is controlling and offer significant advantages in reduced detectability by infrared and radar sensors Low aspect ratio non-axisymmetric nozzles are superior to high aspect ratio non-axisymmetric nozzles and competitive with conventional nozzles in terms of weight and performance for the missions analyzed (Author)

A76-10289 # **Air-cooled ground noise suppressor for afterburning engines using the Coanda effect** M D Nelsen, G J Kass, R E Ballard, and D L Armstrong (Boeing Co , Wichita, Kan) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1328* 9 p Contracts No N00156-72-C-1053, No N00156-73-C-1794

The development of an advanced ground noise suppressor for the U S Navy using the Coanda/Refraction noise reduction concept is discussed This air-cooled demountable unit is designed to a 90 dBA/250-foot acoustic criteria using conventional materials not exposed to direct impingement of the engine exhaust flow The jet deflection and noise reduction principle of the developed suppressor are discussed in detail The results of parametric one-sixth scale model and full-scale tests are presented Adaptability to engine in-airframe applications are also discussed (Author)

A76-10307 # **Practical aerodynamics of the Iak-40 aircraft /2nd revised and enlarged edition/ (Prakticheskaia aerodinamika samoleta Iak-40 /2nd revised and enlarged edition/).** L E Bogoslavskii Moscow, Izdatel'stvo Transport, 1975 152 p In Russian

The design and aerodynamic characteristics and airtechnical specifications of straight-wing airliner are discussed The flying technique is examined, and recommendations to pilots are given for various flight modes Equilibrium, stability, and controllability data are presented, along with guidelines for operating the craft under conditions of turbulence, in power-off flight, under conditions of icing, air bumpiness, etc V P

A76-10318 **Noise-con 75, Proceedings of the National Conference on Noise Control Engineering, Gaithersburg, Md, September 15-17, 1975** Edited by W W Lang (IBM Corp , Armonk, N Y) Poughkeepsie, N Y , Noise Control Foundation, 1975 464 p $30

Papers are presented outlining the activities of various programs in noise research and discussing noise measurement and production standards Some of the topics covered include advances in acoustic research, occupational noise exposure, NASA aircraft noise reduction research and technology program, research in acoustics and noise measurements at the National Bureau of Standards, the USAF noise control program, the role of ANSI in managing noise standards, SAE standards for sound levels of aircraft and automotive vehicles, aerodynamic and acoustical consideration in duct design and performance, and noise generation in pneumatic blow-off guns P T H

A76-10319 **Jet noise - Age 25** A Powell (U S Naval Material Command, Ship Research and Development Center, Bethesda, Md) In Noise-con 75, Proceedings of the National Conference on Noise Control Engineering, Gaithersburg, Md , September 15-17, 1975 Poughkeepsie, N Y , Noise Control Foundation, 1975, p 33-82 142 refs

The paper gives a discussion of the three basic types of noise sources, namely, the monopole, dipole, and quadrupole, and their corresponding noise generation theories - the dilational theory, vortex theory, and the quadrupole theory This serves as a basis for examining the theory of noise in real jets in which account is taken of the effects of convection and refraction The U to the 8th power law of total jet noise is studied and its accuracy evaluated Large-scale eddy motions in jets and the production of edge tones are discussed P T H

A76-10320 **Aircraft noise - A Government point of view.** C R Foster (FAA, Washington, D C) In Noise-con 75, Proceedings of the National Conference on Noise Control Engineering, Gaithersburg, Md , September 15-17, 1975 Poughkeepsie, N Y , Noise Control Foundation, 1975, p 141-150

The goals of the Federal Aviation Administration (FAA) with respect to aircraft noise are defined and discussed The FAA's basic program is directed at aircraft noise source control through (1) engineering research and development implemented by type certification regulations, (2) operation and procedural control designed to minimize noise exposure, and (3) exploring means of developing more compatible land usage to obtain environmental harmony between the airport and the surrounding community P T H

A76-10321 * **NASA aircraft noise reduction research and technology program overview** H W Johnson (NASA, Office of Aeronautics and Space Technology, Aeronautical Propulsion Div , Washington, D C) In Noise-con 75, Proceedings of the National Conference on Noise Control Engineering, Gaithersburg, Md , September 15-17, 1975 Poughkeepsie, N Y , Noise Control Foundation, 1975, p 183-186

A brief outline of the chief areas where NASA is making efforts in aircraft noise research is given This includes studies of the physical basis of aircraft noise and methods for accurately predicting it, the development of practical technologies for noise reduction, and the subjective response of people when exposed to aircraft noise The JT8D Refan Program was to explore whether the noise reduction design concepts used effectively in modern high-bypass engines could also be applied practically and effectively as retrofittable modifications to existing older, low-bypass JT8D engines A program has been completed on developing and demonstrating safe and acceptable flight procedures together with necessary airborne electronics to permit two-segment approaches under either VFR or IFR conditions P T H

A76-10323 **The USAF noise control program - An overview** W E Mabson (USAF, Office of the Secretary, Washington, D C) In Noise-con 75, Proceedings of the National Conference on Noise Control Engineering, Gaithersburg, Md , September 15-17, 1975 Poughkeepsie, N Y , Noise Control Foundation, 1975, p 217-222

The paper identifies and discusses briefly the five main aspects of the Air Force noise control program (1) source noise reduction, (2) conservation of hearing, (3) understanding noise through research, (4) operational constraints and procedures to reduce noise impact, and (5) planning for compatible land use in the vicinity of Air Force installations P T H

A76-10326 **Unsteady aerodynamics, Proceedings of the Symposium, University of Arizona, Tucson, Ariz , March 18-20, 1975 Volumes 1 & 2** Symposium sponsored by the U S Air Force and University of Arizona, Grant No AF-AFOSR-75-2791 Edited by R B Kinney Tucson, Ariz , University of Arizona, 1975 Vol 1, 422 p , Vol 2, 449 p Price of two volumes, $30

Recent advances in the physics and computation of unsteady boundary layers are reviewed, along with modern techniques for dynamic stability Emphasis is placed on the analysis of time-dependent and viscous boundary layers Unsteady airfoil in sonic, transonic, and supersonic flows is examined Other topics discussed include experimental investigation of oscillatory jet-flow effects, separation and reattachment of boundary layers, new solutions to the unsteady laminar boundary layer equations, unsteady potential flow about wings and rotors, and some factors affecting flow unsteadiness in supersonic intakes S D

A76-10327 * **Recent developments in dynamic stall** W J McCroskey (NASA, Ames Research Center, Moffett Field, Calif) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 1 Tucson, Ariz , University of Arizona, 1975, p 35-53 7 refs

Tests were performed on an airfoil in a low-turbulence subsonic wind tunnel at fixed incidence for different speeds of the wind, the airfoil being in translatory motion normal or parallel to the wind The resulting aerodynamic forces and moment on the airfoil were measured along with local pressure and skin friction When the incidence is small and the boundary layer attached, no unsteady effects were observed However, for a large incidence (16 deg), in the case of boundary layer separation, strong unsteady effects are revealed when the boundary layer is reattached in periodic flow Reattachment can be explained assuming that for the same value of free stream velocity, the gradient of the modulus of the periodic component of the relative airspeed at the upper surface of the airfoil in a direction normal to this surface is greater than the gradient of the relative air speed at the upper surface when the airfoil is not oscillating S D

A76-10328 **Separation and reattachment of the boundary layer on a symmetrical aerofoil oscillating at fixed incidence in a steady flow** C Maresca, J Rebont, and J Valensi (Aix-Marseille I, Universite, Marseille, France) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 1 Tucson, Ariz , University of Arizona, 1975, p 35-53 7 refs

Tests were performed on an airfoil in a low-turbulence subsonic wind tunnel at fixed incidence for different speeds of the wind, the airfoil being in translatory motion normal or parallel to the wind The resulting aerodynamic forces and moment on the airfoil were measured along with local pressure and skin friction When the incidence is small and the boundary layer attached, no unsteady effects were observed However, for a large incidence (16 deg), in the case of upper surface boundary layer separation, strong unsteady effects are revealed when the boundary layer is reattached in periodic flow Reattachment can be explained assuming that for the same value of free stream velocity, the gradient of the modulus of the periodic component of the relative airspeed at the upper surface of the airfoil in a direction normal to this surface is greater than the gradient of the relative air speed at the upper surface when the airfoil is not oscillating S D

A76-10329 **Experimental results for an airfoil with oscillating spoiler and flap** J D Lang (U S Air Force Academy, Colorado Springs, Colo) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 1 Tucson, Ariz , University of Arizona, 1975, p 55-80 9 refs USAF-supported research

In order to study separating and reattaching flowfields in incompressible flow, an experimental program is designed which includes a series of tests involving an airfoil model with a single movable fence type spoiler and plain flap Testing involved different model configurations and parameter variations The program aimed at investigating the dependence of pressure and hinge-moment coefficients on nondimensional parameters such as Reynolds number, frequency parameters, mean spoiler height, spoiler oscillation amplitude, and flap angle Other parameters studied are spoiler chordwise position, ratio of mean spoiler height to boundary-layer displacement thickness, free stream turbulence level, airfoil angle of attack, flap inertia, flap structural stiffness, and spoiler span Results obtained for steady-flow and unsteady flow testings are summarized Findings confirm that a separating and reattaching flowfield is an extremely complex entity At very low frequencies unsteady effects are significant, but over the range of frequencies considered the modifications to this nonlinear phenomenon follow a near-linear trend S D

A76-10330 **Recent advances in techniques for dynamic stability testing at NAE** K J Orlik-Ruckemann (National Aeronautical Establishment, Ottawa, Canada) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 1 Tucson, Ariz , University of Arizona, 1975, p 81-104 14 refs

Some of the dynamic stability techniques developed recently at the National Aeronautical Establishment are reviewed, along with the rationale behind their development and potential applications The review includes dynamic half-model experiments at moderate angles of attack, dynamic interference experiments with two oscillating models, oscillatory experiments on models with simulated exhaust plume, dynamic cross-coupling experiments, and vertical acceleration experiments These techniques are expected to prove useful in obtaining new data that might be essential for a successful stability analysis of modern aerospace vehicles S D

A76-10339 **Unsteady flow phenomena causing weapons fire-aircraft engine inlet interference problems - Theory and experiments** A Wortman (AWE Co , Santa Monica, Calif) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 1 Tucson, Ariz , University of Arizona, 1975, p 299-313 5 refs

It is generally assumed that the interference of cannon fire with the operation of jet engines is due to the flow of the gun gases into the engine inlet ducts Experiments conducted in a ballistic test range using a cannon from the Northrop F-5A aircraft, were used to test this assumption An analytical modeling profiling the shock wave propagation in the gun gas flow is presented It is concluded that the ingestion of the gun gas has only a minor effect on the overall interference problem B J

A76-10340 **Some factors affecting the flow unsteadiness in supersonic intakes** A R Seed (National Gas Turbine Establishment, Farnborough, Hants , England) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 1 Tucson, Ariz , University of Arizona, 1975, p 315-335 7 refs

Some factors in the cost effective design of a two dimensional supersonic intake, which are shown to have a direct effect on the levels of flow instability in the flow entering the engine, are discussed The main requirements of a supersonic intake are maximum internal pressure recovery, minimum flow distortion and turbulence, minimum external drag, and stable flow range to cope with flow transients Some of the problems considered are shock-boundary layer interactions, the intersection of shock waves in the intake capture flow, and the minimization of turbulence B J

A76-10341 **Transonic buffet response testing and control** R M Scruggs and J G Theisen (Lockheed-Georgia Co , Marietta, Ga) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975, Volume 1
Tucson, Ariz , University of Arizona, 1975, p 337-357 26 refs

The implications of dynamic stall as an agent in cases of catastrophic failure in high-speed aircraft maneuvers are analyzed on the basis of flight-test and wind tunnel test data The attenuation of buffet pressure fluctuations by spanwise blowing across outboard wing sections is experimentally demonstrated, and a vortex lattice (VISI) computer model of this technique of vortex-lift control is presented The axial flow and trajectory of the jet and the vortex behind the leading-edge feeding sheet are represented by source-and-sink distributions The possible existence of an aeroelastic torsion-mode instability in resonance with the Strouhal shedding frequency is hypothesized for the F-4 airplane, and a preliminary stall-hysteresis theory and analysis is given C K D

A76-10342 **On modeling aerodynamically induced non-linear responses of self-excited structures** A O Saint Hilaire (United Technologies Research Laboratories, East Hartford, Conn) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 1 Tucson, Ariz , University of Arizona, 1975, p 359-392 24 refs

A procedure for solving certain flow-structure interaction problems is described, with special emphasis on modeling the nonlinear response signatures of self-excited systems Three problems are treated (1) the semi-empirical modeling of the cylinder response to vortex shedding, (2) a formulation of the harmonium reed problem, emphasizing the derivation of linear and nonlinear pressure force distributions, (3) the nonlinear aspects of the torsional stall flutter problem of the flat-plate wing B J

A76-10343 **Experimental investigation of oscillatory jet-flow effects** M F Platzer, L J Deal, Jr , and W S Johnson (U S Naval Postgraduate School, Monterey, Calif) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 1 Tucson, Ariz , University of Arizona, 1975, p 393-414 26 refs Navy-supported research

The paper describes some studies of oscillatory jet flows for the purposes of gust alleviation and thrust augmentation Windtunnel tests were performed on an airfoil with fluidically actuated jet flap to test its effectiveness in reducing torsional oscillations due to a sinusoidal gust field Gust control was achieved by using an open loop control system With control on, wing oscillations were found to remain fairly constant at plus or minus 5 deg at any frequency of the gust field An oscillatory jet nozzle with improved thrust augmentation characteristics is also described P T H

A76-10346 * **Numerical solutions of the unsteady Navier-Stokes equations for arbitrary bodies using boundary-fitted curvilinear coordinates** J F Thompson, F C Thames, R L Walker, and S P Shanks (Mississippi State University, Mississippi State, Miss) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 2 Tucson, Ariz , University of Arizona, 1975, p 453-485 6 refs Grant No NGR-25-001-055, Contract No N00014-74-C-0373-P0001

A method of automatic body-fitted curvilinear coordinate generation is described and used to construct a finite-difference solution of the full incompressible time-dependent Navier-Stokes equations for the unsteady laminar viscous flow arbitrary two-dimensional airfoils or any other two-dimensional body A method of controlling the spacing of the coordinate lines encircling the body is developed in order to treat high Reynolds number flows, since the coordinate lines must concentrate near the surface to a greater degree as the Reynolds number increases Multiple airfoils and submerged hydrofoils are treated as illustrative examples The solution shows good agreement with the Blasius boundary layer solution for the flow past a semi-infinite flat plate S D

A76-10347 **Impulsive motion of an airfoil in a viscous fluid.** R B Kinney and Z M Cielak (Arizona, University, Tucson, Ariz) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 2
Tucson, Ariz , University of Arizona, 1975, p 487-512 11 refs NSF Grant No ENG-73-03855A01

A numerical procedure is proposed for calculating the unsteady viscous flow about an airfoil impulsively started from rest The procedure is a marked departure from those commonly used in that kinematical relationships between vorticity and velocity are employed in a manner which is reminiscent of ideal-fluid analyses In particular, the bond and free vorticity distributions are determined at each instant of time such that the viscous adherence condition on the velocity field is satisfied at the solid boundaries The proposed procedure appears to be well suited to high Reynolds number flows as well S D

A76-10350 * **Unsteady transonic aerodynamics - An aeronautics challenge** J R Spreiter (Stanford University, Stanford, Calif) and S S Stahara (Nielsen Engineering and Research, Inc , Mountain View Calif) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18 20, 1975 Volume 2 Tucson, Ariz , University of Arizona, 1975, p 553-581 31 refs Contracts No N00014 73-C-0379, No NCAR-745-427 NR Project 061-215

The paper presents a review of the historical development in unsteady transonic aerodynamics, along with the foundations and accomplishments of several approaches to solve the equations of unsteady transonic flow The discussion covers the linearized unsteady flow theory, numerical solution of the exact equations for an inviscid compressible gas, nonlinear small disturbance theory of transonic flow and linearization of the unsteady component about the nonlinear solution for the steady state, local linearization solution for unsteady transonic flow, unsteady transonic flow theory for slender wings and bodies, and three-dimensional unsteady transonic flows The relation between the calculated results and experiment is examined It is shown that the newly emerging numerical methods are capable of solving the nonlinear equations for two-dimensional flow and can be extended to three dimensional flows S D

A76-10351 * **Numeric calculation of unsteady forces over thin pointed wings in sonic flow** K R Kimble and J M Wu (Tennessee, University, Tullahoma, Tenn) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz , March 18-20, 1975 Volume 2 Tucson, Ariz , University of Arizona, 1975, p 583-607 9 refs Grant No NGR 43-001-102

A fast and reasonably accurate numerical procedure is proposed for the solution of a simplified unsteady transonic equation The approach described takes into account many of the effects of the steady flow field The resulting accuracy is within a few per cent and can be carried out on a computer in less than one minute per case (one frequency and one mode of oscillation) The problem concerns a rigid pointed wing which performs harmonic pitching oscillations of small amplitude in a steady uniform transonic flow Wake influence is ignored and shocks must be weak It is shown that the method is more flexible than the transonic box method proposed by Rodemich and Andrew (1965) in that it can easily account for variable local Mach number and rather arbitrary planform so long as the basic assumptions are fulfilled S D

A76-10352 **An experimental investigation of unsteady airfoil motion in a supersonic stream** A S Novick, R L Jay, G T Sinnet, and S Fleeter (General Motors Corp., Detroit Diesel Allison Div, Indianapolis, Ind) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz, March 18-20, 1975 Volume 2 Tucson, Ariz, University of Arizona, 1975, p 609-629 11 refs

The unsteady pressure distribution (unsteady lift and moment) on an airfoil surface and its phase relation to cascade blade motion in a supersonic inlet flow are investigated using a completely automated wind tunnel facility with two dedicated digital computers The experimental results of an initial single airfoil oscillating at two torsional frequencies are presented in terms of the phase shift of the time-dependent pressure distribution on the pressure and suction surfaces with reference to the airfoil rotation The data obtained are correlated with an appropriate small perturbation analysis The data and the analysis are found to be in good qualitative agreement The quantitative agrement between the small perturbation theory and the experiment for both frequencies at the 20% chord location on the pressure surface is excellent On the suction surface, however, there is a small phase shift difference S D

A76-10353 **Effects of compressibility in unsteady airfoil lift theories** R K Amiet (United Technologies Research Laboratories, East Hartford, Conn) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz, March 18-20, 1975 Volume 2. Tucson, Ariz, University of Arizona, 1975, p 631-653 21 refs

The paper reviews and extends some of recent solutions to the problem of a flat plate airfoil in an unsteady compressible subsonic flow within the framework of linearized theory Incompressible flow results are briefly examined The compressible flow problem is treated in two ranges in which average acoustic wavelength is either greater or less than the airfoil quarter chord Two analytical solutions are presented which give accurate predictions of the airfoil lift with an error of about 10% as compared to available numerical solutions The two solutions cover the entire range of reduced frequency and Mach number less than unity S D

A76-10354 **A simplified theory of oscillating airfoils in transonic flow** E H Dowel (Princeton University, Princeton, N J) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz, March 18-20, 1975 Volume 2 Tucson, Ariz, University of Arizona, 1975, p 655-679 11 refs

A rational approximate method based on the local linearization concept is developed and applied to the steady motion of an airfoil of finite thickness in two dimensional flow The problems of unsteady airfoil motion in two-dimensional and three-dimensional supersonic flows are also treated Green functions derived by the present method are used for the three-dimensional calculations B J

A76-10356 ***Response of a nozzle to an entropy disturbance* - Example of thermodynamically unsteady aerodynamics** F E Marble (California Institute of Technology, Pasadena, Calif) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz, March 18-20, 1975 Volume 2 Tucson, Ariz, University of Arizona, 1975, p 699-717

Thermodynamically unsteady aerodynamics - in contrast to kinematically unsteady aerodynamics - presents itself when the undisturbed gas stream temperature or density is unsteady although the velocity and pressure are steady, such nonuniformities are associated with entropy variations from point to point in the stream The paper presents one case of such flows related to nonuniform entropy regions passing through a nozzle in ducted flow Perturbation theory and compact nozzle theory are applied to the thermodynamically unsteady flow through supercritical nozzles of finite length The frequency dependence of nozzle-entropy interaction is considered B J

A76-10357 **On lifting-line theory in unsteady aerodynamics** H K Cheng (Southern California, University, Los Angeles, Calif) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz, March 18-20, 1975 Volume 2 Tucson, Ariz, University of Arizona, 1975, p 719-739 18 refs Contract No N00014-75-C-0520

Linear lifting-line theory is applied to a high-aspect-ratio planar wing with a curved center line undergoing unsteady motion in an incompressible flow with a uniform freestream The most significant of the results is the absence of the global three dimensional effect in the intermediate and higher frequency ranges The theory confirms that when the wavelength (based on frequency and flow velocity) is short compared with the wing span, the effect produced by the periodic vorticity in the far wake tends to average itself out, eliminating the global three dimensional effect typical of airfoil theories in steady flow B J

A76-10358 * **Some examples of unsteady transonic flows over airfoils** W F Ballhaus (NASA, Ames Research Center, Moffett Field, U S Army, Air Mobility Research and Development Laboratory, Los Altos, Calif), R Magnus, and H Yoshihara (General Dynamics Corp, Convair Div, San Diego, Calif) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz, March 18-20, 1975 Volume 2 Tucson, Ariz, University of Arizona, 1975, p 769-791 8 refs

A finite difference flutter analysis is presented for the NACA 64A-410 airfoil at M equals 0 72, where the incidence is abruptly changed from 2 to 4 degrees The effect of gust loads is studied, and the unsteady flow adjusting process is displayed The semi-implicit procedure of Ballhaus and Lomax (1974) is used to solve the small disturbance transonic potential equation The physical aspects of the results, rather than the numerical details, are emphasized B J

A76-10359 **Forces on unstaggered airfoil cascades in unsteady in-phase motion with applications to harmonic oscillation** N H Kemp (Avco Everett Research Laboratory, Inc, Arlington, Mass) and H Ohashi (Tokyo, University, Tokyo, Japan) In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz, March 18-20, 1975 Volume 2 Tucson, Ariz, University of Arizona, 1975, p 793-826 22 refs

Incompressible flow through an unstaggered cascade in general, unsteady, in-phase motion is considered By methods of thin-airfoil theory, using the assumptions of wakes trailing back at the through-flow velocity, and the Kutta condition, exact analytical expressions are derived for loading, lift and moment As applications, harmonic motion is considered for bending, pitching, sinusoidal gusts, and generalized gusts Numerical values of lift and moment for the first three cases are given graphically (tables are available from the authors) The results show strong analogies with isolated unsteady thin-airfoil theory They should prove useful as simple examples of unsteady effects in cascades, and as check cases for other approximate or purely numerical analyses (Author)

A76-10360 * **Subsonic flow past an oscillating cascade with steady blade loading - Basic formulation** J M Verdon, J R Caspar (United Technologies Research Laboratories, East Hartford, Conn), and J J Adamczyk (NASA, Lewis Research Center, Cleveland, Ohio). In Unsteady aerodynamics, Proceedings of the Symposium, Tucson, Ariz, March 18-20, 1975 Volume 2 Tucson, Ariz, University of Arizona, 1975, p 827-851 16 refs Research supported by the United Technologies Corp

A nonlinear boundary value problem governing the subsonic flow in a single, extended, blade passage region of a high deflection, two dimensional, oscillating cascade is derived The blades are assumed to be undergoing identical harmonic motions of small amplitude with constant phase angle between the motion of adjacent blades An asymptotic perturbation approach is used to determine the velocity potential This formulation can be used in the numerical determination of unsteady potential and thus the unsteady aerodynamic force and moment under various combinations of cascade and flow parameters B J

A76-10389 **International air transportation, Proceedings of the Conference, San Francisco, Calif, March 24-26, 1975** Conference sponsored by the American Society of Civil Engineers San Francisco, American Society of Civil Engineers, 1975 248 p $6 00

Papers are presented dealing with the effect of the energy crisis on the air transport industry, the development of short-haul transportation, aircraft noise reduction, and airfield capacity studies Some of the topics covered include the effect of fuel price rises on commercial aircraft design, Canadian experience with short-haul air transport, an airline and airport viewpoint on reducing the impact of aircraft noise, methods of determining airport capacity and delay, wake vortex program status, and ways and means to implement an airport environs area plan

P T H

A76-10390 # **The airlines' prospect after the 1974 energy crisis** P A Biemond (KLM - Royal Dutch Airlines, Amsterdam, Netherlands) In International air transportation, Proceedings of the Conference, San Francisco, Calif, March 24-26, 1975 San Francisco, American Society of Civil Engineers, 1975, p 3-17

Views and facts are presented on the predicted impact of the 1974 fuel crisis on airline business prospects Attention is called to (1) the posted airport prices, which are often wrongly taken for true price indicators, (2) the into-plane distribution concessions, which prevent the buying of spot sales, (3) the need for more viable spot and forward markets, and (4) the need for more openness in pricing, free access to the market from all sides, and a better organized forward price coverage system P T H

A76-10391 # **The 1974 energy crisis - A perspective - The effect on commercial aircraft design** J E Steiner (Boeing Commercial Airplane Co, Renton, Wash) In International air transportation, Proceedings of the Conference, San Francisco, Calif, March 24-26, 1975 San Francisco, American Society of Civil Engineers, 1975, p 19-31

The paper identifies some aspects of aircraft design which have been and will be strongly affected by the design criterion of minimum fuel usage necessitated by the increased fuel costs in airline operation Nonfan aircraft have either been retired or refurbished Reduction of cruise speed yielded much greater savings on fuel than the increase in such items as crew pay account Rescheduling was done to achieve higher load factors Development of simple refan and high-bypass engines is necessary, but will also entail redesign of airfoil and airframe for optimal performance Higher aspect ratio wing and cruise speed optimization will provide lower trip fuel, reduced engine size, and increased fuel volume More accurate flying will result in fuel savings, which will hinge on automation in ATC and advanced navigation capability in aircraft P T H

A76-10392 # **The effect of the energy crisis on economic regulation of the air transport industry** R D Timm (Civil Aeronautics Board, Washington, D C) In International air transportation, Proceedings of the Conference, San Francisco, Calif., March 24-26, 1975 San Francisco, American Society of Civil Engineers, 1975, p 33-37

The paper discusses some of the responses of the Civil Aeronautics Board when several major U S. carriers were faced with severe financial problems as a result of higher debt, higher interest rates, inflation costs, and the energy crisis Three policies are significant (1) the Board held route authority expansion, particularly competitive expansion, to a minimum by not setting new cases in light of other matters requiring the Boards's urgent attention, (2) the Board established standards for adjusting rates to costs in the Domestic Passenger Fare Investigation, and (3) the Board began to monitor poor performance and encourage service improvements

P T H

A76-10393 * # **Review of NASA short-haul studies** G C Kenyon (NASA, Ames Research Center, Systems Studies Div, Moffett Field, Calif) In International air transportation, Proceedings of the Conference, San Francisco, Calif, March 24-26, 1975 San Francisco, American Society of Civil Engineers, 1975, p 41-65 20 refs

The paper summarizes the results of NASA-conducted technological and economic studies of low, medium, and high density short haul transportation systems Aircraft concepts considered included CTOL, RTOL, STOL, and general aviation aircraft For low density systems, it was found that viable air service becomes possible if city pairs are at least 100 km apart and a two-way total travel demand of at least 200 daily passengers exists Currently available aircraft were found suitable The medium-density study showed that a 60-passenger twin engine turbofan was the best suited aircraft For high density systems, STOL appears to be an economically viable means of reducing noise and congestion at major hub airports Adequate runways 914 m in length or greater either already exist or could be added to most existing major hub airports P T H

A76-10394 # **Canadian experience with short haul air transport** A J Tonkin (Airtransit Canada, Montreal, Canada) In International air transportation, Proceedings of the Conference, San Francisco, Calif, March 24-26, 1975 San Francisco, American Society of Civil Engineers, 1975, p 67-71

The paper describes the objectives, structure, and some preliminary results of an STOL demonstration service in effect since July, 1974 The purposes of the service were to develop technical and operational components of STOL air transportation, obtain data on passenger and community reaction to STOL transport, and evaluate the economics of STOL service Modified DHC-6 Twin Otters constitute the STOL fleet for regular service between downtown Montreal and downtown Ottawa Over the next two years, the Twin Otters will fly in a total STOL environment, following special instrument landing and departure procedures and using different airlanes between the two cities than those used by conventional aircraft P T H

A76-10396 # **Reducing the impact of aircraft noise - An airline viewpoint** E Eula (Compagnia Nazionale ALITALIA, Rome, Italy) In International air transportation, Proceedings of the Conference, San Francisco, Calif, March 24-26, 1975 San Francisco, American Society of Civil Engineers, 1975, p 93-108

Airline views are expressed on the four categories of action taken to solve the aircraft noise problem (1) controlling noise at the source, (2) controlling aircraft noise by appropriate flight procedures, (3) controlling noise by restricting the type of aircraft operable at a given airport and limiting operating hours, and (4) development of airport surroundings A case is made against retrofitting or modifying aircraft in service The cost of retrofitting is such that operators would be encouraged to extend the useful life of the affected aircraft, delaying their retirement in lieu of acquiring more modern aircraft It is argued that the two-segment landing approach will not significantly reduce noise levels and will hamper flight safety and increase cockpit workloads P T H

A76-10397 # **Reducing the impact of aircraft noise - An airport viewpoint** W Treibel In International air transportation, Proceedings of the Conference, San Francisco, Calif, March 24-26, 1975 San Francisco, American Society of Civil Engineers, 1975, p 109-120 9 refs

The paper reviews the policy of the Airport Association Coordinating Council (AACC) with regard to measures for reducing aircraft noise and emphasizes some points of special importance for the airports in this respect Airport associations are very concerned that further delays in the starting of the retrofit program might lead to drastic flight restrictions in international air [illegible] c The associations regret that IATA does not understand the environmental needs of the airports The pressure of the public through anti-noise groups and infuential organizations is still not considered well enough It is argued that proposals to replace a large number of older noisy aircraft by new quieter types instead of or in connection with the retrofit program is a very costly solution P T H

A76-10399 # **Wake vortex program status** D R Israel (FAA, Washington, D C) In International air transportation, Proceedings of the Conference, San Francisco, Calif , March 24 26, 1975 San Francisco, American Society of Civil Engineers, 1975, p 143-160 7 refs

The paper describes past results, present status, and future outlook and approaches of programs for studying wake vortex behavior and reduction of its effects The main characteristics of several vortex sensing systems are examined, including a pulsed acoustic vortex sensing system, a Doppler acoustic sensing system, a ground wind sensing system, and a laser Doppler system Three stages in the life of an aircraft wake have been discerned by recent study the inviscid wake stage, the entraining wake stage, and the decaying wake stage A prototype vortex advisory system for a large airport is described P T H

A76-10513 **Titanium alloy castings (Pièces coulées en alliages de titane)** P Merrien and A Barbier (Messier-Hispano, S A , Arudy, Basses-Pyrenées, France) *L'Aéronautique et l'Astronautique,* no 52, 1975, p 29-35 In French

Fusing, casting, and soldering methods in the production of titanium alloy parts are summarized, with attention given to the application of the electron beam furnace The mechanical characteristics of molded TA6V alloy are given Cost advantages of mold casting are discussed, and means of reducing overall production costs are considered Complex solid and hollow profiles may be obtained in mold castings, and mechanical characteristics almost equivalent to those of dye castings have been attained Applications of TA6V mold castings in aircraft produced in 1975 are outlined C K D

A76-10517 **Antivibration insulation in the aeronautics field (L'isolation antivibratile dans le domaine aéronautique).** *L'Aéronautique et l'Astronautique,* no 52, 1975, p 85, 86 In French

Guidelines for determination of the optimal characteristics of antivibration and shock insulation for various types of aircraft are given Characteristics of the dynamic environment to which such materials are subjected including the vibration levels, accelerations corresponding to a range of aircraft maneuvers, and the shock spectrum in varying circumstances are considered The influence of static parameters (weight and center of gravity) and choice of montage is discussed C K D

A76-10518 **LMT - The training simulator for Concorde (L M T - Le simulateur d'entrainement pour Concorde)** *L'Aéronautique et l'Astronautique,* no 52, 1975, p 87-89 In French

The Concorde training simulator will be used to develop a thorough knowledge of the aircraft systems, and to provide training in all flight configurations and operational procedures The cockpit is identical in size and plan to that of the real aircraft The instructor may vary environmental parameters at all points during the course of flight simulation, and simulated instrument or systems failures may be preprogrammed or introduced directly A closed circuit television system permits lesson play-back C K D

A76-10555 # **The fatigue substantiation of the Lynx helicopter** A D Hall (Westland Helicopters, Ltd , Yeovil, Somerset, England) *Aircraft Engineering,* vol 47, Oct 1975, p 4-8, 10-17 5 refs

This article outlines procedures used to establish the fatigue lives of the dynamic and structural components of the Lynx and to demonstrate how an adequate safety level is achieved under the loading sustained by the aircraft A brief introduction to the phenomenon of fatigue is provided to show how it is applicable to a helicopter A description is given of the fatigue testing, flight testing and substantiation procedures used with the Lynx, and it is shown how the eventual fatigue lives are estimated Some thoughts are set forth about the future of fatigue substantiation (Author)

A76-10556 # **Aircraft stopping systems** *Aircraft Engineering,* vol 47, Oct 1975, p 18-22

The design and operation of a typical aircraft stopping system are discussed The properties of carbon brakes are outlined and compared with those of conventional brakes Principal advantages of the carbon construction are light weight and the ability of the carbon heat sink to remain operational under high-energy Rejected Take-Off conditions The Dunlop OSCAR (Optimum System for the Control of Aircraft Retardation) a 'quasi-slip' type electronic/hydraulic skid control system, is described Electrical brake pressure metering systems and a control system based on control of brake torque rather than brake pressure are discussed Both features have been included in development programs for the Concorde brake system C K D

A76-10557 # **Aircraft power transfer units** C Wise (Sperry Rand Corp , Sperry Vickers Div , Troy, Mich) *Aircraft Engineering,* vol 47, Oct 1975, p 23, 24, 28

Use of a power transfer unit assures adequate hydraulic power to all systems in the event of failure of an engine or engine-driven pump by allowing power to be drawn for another system In a simple non-integrated power transfer package the shafts of two identical fixed-displacement hydraulic motors (typically Sperry Vickers bent-axis motors) are mechanically coupled and the two housings are bolted together Integrated systems consist primarily of two rotating groups mechanically coupled together by a common drive shaft and packaged in a single split housing, and are the systems of choice for applications in which size and weight are major considerations The relationship of torque efficiency to starting power of power transfer units is discussed Applications of a uni-directional design, which offers a wide range of pump flow and pressure combinations for a specified motor input, are described C K D

A76-10558 # **Hydraulic servicing - A manufacturer's view** A C Radford (HML /Engineering/, Ltd , Isleworth, Middx , England) *Aircraft Engineering,* vol 47, Oct 1975, p 26-28

A review of the development of testing and servicing units for aircraft hydraulic systems is presented A 40 hp servicing trolley which has an interchangeable gas engine or electric motor power plant is described The unit has an output suitable for aircraft requiring up to 350 bar at 30 L/min or 56 L/min at 210 bar, and can service a wide range of fixed and rotating wing machines A flow splitting device enables the division of the output in any combination of the total Test rigs used with the Concorde are briefly discussed, and future trends are considered C K D

A76-10694 **Vibration characteristics of two types of subsonic profiles (Caractéristiques de tremblement de deux types de profils subsoniques)** J Tensi and L F Tsen (Poitiers, Université, Poitiers, France) *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques,* vol 281, no 11, Sept. 15, 1975, p 149-152 7 refs. In French

Wind tunnel test for two types of profiles were conducted under stall conditions and the vibration characteristics of the profiles were compared One profile was thin with leading edge detachment, while the other was thick with trailing edge detachment Random trembling forces due to instabilities in the detached flow were measured and their spectral distribution studied P T H

A76-10701 # **A method for analyzing the stability of a wing in flight (Ob odnom metode analiza ustoichivosti kryla v polete)** S P Strelkov, N D Tarankova, and A A Kharlamov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) *Moskovskii Universitet, Vestnik, Seriia III - Fizika, Astronomiia,* vol 16, May-June 1975, p 259-265 In Russian.

The problem of determining the critical flight speed and critical vibration frequency for flectional-torsional flutter is solved as a boundary-value problem for a distributed elastic system Exact values are determined for these critical parameters by analog computer, and vibrational modes are calculated for a nonuniform wing during flutter The results are compared with approximate values given by the Bubnov-Galerkin technique F G M

A76-10713 # **On aerodynamic coefficients of arbitrary biplane wing sections** W J Prosnak and M E Klonowska (Warszawa, Politechnika, Warsaw, Poland) *Académie Polonaise des Sciences, Bulletin, Série des Sciences Techniques,* vol 23, no 6, 1975, p 21 (527) 28 (534) 7 refs

Aerodynamic coefficients of an arbitrary biplane wing section as well as of each particular profile regarded separately, but in hydrodynamic interaction with the remaining one, are considered in the paper In both the cases formulae for the coefficients are derived The formulae are analogous to those stemming from the Zhukovskii theory and concerning the single profile All of them depend in an explicit manner on the incidence angle, and contain some constants representing exclusively the geometry of the section The constants referring to the whole biplane wing section are given in a closed form, in terms of an appropriate mapping function (Author)

A76-10714 **The revolution in production processes** I Stambler *Interavia,* vol 30, Oct 1975, p 1099-1103

Improvements in management practices, with teams combining production shop experience and familiarity with R&D, have proved effective in cutting lead time from experimentation to actual production Production processes such as laser welding and cutting, large-scale diffusion bonding, laser heat treatment, fluxless brazing, combined adhesive bonding and mechanical joining (riveting, weld ing), ultrasonic bonding and ultrasonic drilling, are proving not only feasible in production, but indispensable in processing materials refractory to conventional cutting and joining methods, and often in cutting production costs Applicability of numerical control, adaptive control, and computer aided manufacturing technology to these processes (including heat treatment) is discussed R D V

A76-10838 # **State of development and effectiveness of flying cranes in the GDR (Entwicklungsstand und Leistungsfähigkeit des Kranfluges in der DDR).** H Vogt (Gesellschaft fur Internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 11, no 4, 1975, p 192-196 In German

The paper gives an outline of the growth of the application of helicopters for lifting, suspending, and placement of very heavy objects in East Germany from 1959 to the present At first, the Mi-4 helicopter was used, which carried an average load of 700 kgf In 1963, 90 flight hours by helicopter crane were recorded A qualitative jump in the development of flying cranes was made with the appearance of the Soviet turbine helicopter Mi-8, which could lift up to 3 Mgf In 1974, 540 flight hours were recorded for 126 applications Helicopter cranes have been used in foundry repairs, mounting and dismantling of smokestacks, and in the electrification of railroad lines Some future prospects for the use of helicopter cranes are mentioned P T H

A76-10839 # **Prospective development of helicopter cranes for higher load levels (Perspektivische Entwicklung des Kranfluges in höhere Lastbereiche)** S Sassor (Gesellschaft fur Internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 11, no 4, 1975, p 204-208 In German

The paper discusses possibilities of using helicopters for crane operations with greater lifting capacity than the Mi-8, that can lift a load of up to 3 Mgf Promising vehicles would be the Mi-10 with 10 Mgf maximum payload and the M 12 with 20 Mgf lifting capacity For higher load levels, an undulating-drive airship as maneuverable as a helicopter has been proposed Cost comparisons are made between helicopter cranes and ordinary cranes P T H

A76-10840 # **Experience in the use of helicopters in industrial operations (Erfahrungen beim Hubschraubereinsatz in Industriebetrieben).** H Körner (VEB GISAG, Giesserei und Maschinenbau, Bernsdorf, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 11, no 4, 1975, p 209, 210 In German

The paper describes the success obtained in using helicopter cranes in certain foundry assembly operations where the use of ordinary erecting masts was too slow or awkward The Mi-4 helicopter has been used in the GDR for such operations up to 1968 At that time, Mi-8 turbine helicopters were introduced in crane operations in which loads of up to 3,000 kgf could be handled From 1964 to 1974, one foundry and machine construction firm called for 205 helicopter crane applications involving a total of 5,500 Mgf of construction elements and 368 hours flying time during mounting and dismantling operations P T H

A76-10841 # **Considerations concerning the economic and operational effectiveness of using helicopters in the electrification of railroads (Gedanken zur okonomischen und betrieblichen Bedeutung des Hubschraubereinsatzes bei der Streckenelektrifizierung der Eisenbahn)** W Neubert (Ministerium fur Verkehrswesen, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luft fahrt,* vol 11, no 4, 1975, p 211, 212 In German

A76-10842 # **Thrust in aircraft powerplants (Der Schub bei Luftfahrzeugantrieben)** V V Shashkin (Akademiia Tsivilnoi Aviatsii, Leningrad, USSR) and E Schesky (Hochschule fur Verkehrswesen, Dresden, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 11, no 4, 1975, p 213 218 In German

The basic characteristics of the Otto cycle and the Joule cycle, as they are realized in aircraft piston engines and gas turbine engines, are analyzed Energy and thrust conversion in both cycles is considered from a unified viewpoint Special attention is given to magnitude of thrust in relation to the internal power yield and the dependence of thrust on flight speed The influence of mean effective working pressure in piston engines and of specific work and the bypass ratio in gas turbine engines is closely examined P T H

A76-10843 # **Basic concepts of a progressive maintenance system II (Grundlagen eines progressiven Instandhaltungssystems II).** A Domokos (Magyar Legikozlekedesi Vallalat, Budapest, Hungary) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 11, no 4, 1975, p 223-227 In German

The paper examines general problems in the application of a computer for an aircraft repair and maintenance system The computer would determine maintenance cycles on the basis of the type of defects encountered, past flying time, and expected future flying time Considerations for coding of structural elements for minimum defect analysis time are discussed Problems in schedule optimization are examined P T H

A76-10845 # **The Dolphin airship with undulating drive - Undulators with rigid or elastic blade with different undulator diameter at rest and during circular running (Delphinluftschiff mit Wellantrieb - Weller mit starrem oder elastischem Blatt bei verschieden grossem Wellkreisdurchmesser am Stand und in Fahrt am Rundlauf).** W Schmidt (Kammer der Technik, Dresden, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 11, no 4, 1975, p 235-240 12 refs In German

Tests were conducted to determine the effect of undulator diameter on thrust for rigid and elastic undulators under different operating regimes The undulator with rigid blade is less efficient as its diameter becomes smaller in relation to the blade depth At a diameter of about one-third the depth, it furnishes almost no thrust For an elastic undulator, thrust is not significantly reduced as diameter becomes smaller P T H

A76-11097 **Aerodynamic profiles (Sur les profils aérodynamiques)** G Couchet and R Laporte (Montpellier II, Université, Montpellier, France) *Journal de Mécanique,* vol 14, no 3, 1975, p 523-530 7 refs In French

In conformal mapping of unbounded simply connected areas, sufficient conditions expressed in different equivalent forms are conventionally used It is shown that this equivalence no longer holds for a boundary with more than one corner point The generation by conformal mapping of a profile with more than one corner point is demonstrated V P

A76-11100 # **Concorde now /The Sholto Douglas Memorial Lecture/** G Edwards *Tech Air,* vol 31, Nov 1975, p 2 12

The Sholto Douglas Memorial Lecture delivered in Sept 1975 deals entirely with Concorde, covering the history of the concept and the technical challenge presented by the contrasting physical environments in which Concorde is built to function The problems of compatibility with airports designed for conventional subsonic jet aircraft, kinetic heating at supersonic speeds (from 15 C at sea level through minus 20 C at 30,000 feet to plus 120 C at 50000 feet cruise height), extensive flight testing, power plant details, ground testing and reliability are discussed together with problems pertaining to ecology and the environment, including noise levels R D V

A76-11132 # **New automatic fatigue test system for compressor blade** H Aono and T Chikada *Ishikawajima-Harima Engineering Review,* vol 15, July 1975, p 523-527 In Japanese, with abstract in English

A fatigue test system for axial-flow and compressor blades is described, and the results of tests to determine the fatigue characteristics of compressor blades are presented The system is completely automatic except for the initial positioning of test specimens An electro-dynamic exciter vibrates the test blades and continuously controls vibrational levels and frequencies Vibration is stopped automatically when the test specimen runs out or cracks Data are stored by an X-Y recorder C K D

A76-11134 **Dassault-Breguet - From the Mercure-100 to the Mercure-200 I (Dassault-Breguet - Du Mercure-100 au Mercure-200 I)** J Morisset *Air et Cosmos,* vol 13, Oct 11, 1975, p 23-27 In French

The Mercure-200 will be a twin-jet, transport aircraft developed by modifying the Mercure-100 and powered by two high bypass engines of 10-ton thrust mounted below the wing The nacelles were designed by computer to give what is in principle an optimal design, and wind tunnel tests on a 1/14 model are in progress The revolving parts of the engine are situated ahead of the wing fixture for safety, and the long nacelle and mixing of cold and hot flows should yield higher performance, a 28% counterthrust, and maximum reduction of primary jet noise The fuselage will be longer by 2 or 4 meters in comparison with the Mercure-100 Cost analysis showed that it would not be advantageous to develop a supercritical airfoil, so the airfoil of the Mercure-100 has been retained with the necessary modifications due to the optimized nacelles First prototype flight is scheduled for 1978, while production aircraft may be available by 1979 provided a decision is made early in 1976 P T H

A76-11135 **Dassault-Breguet - From the Mercure-100 to the Mercure-200 II (Dassault-Breguet - Du Mercure-100 au Mercure-200 II)** J Morisset *Air et Cosmos,* vol 13, Oct 18, 1975, p 16-18 In French

The paper presents basic data on consumption, size, weight, range, and takeoff and landing characteristics of the civil transport aircraft Mercure-200 The engine used will be the CFM-56, which offers a specific consumption less than 30% that of motors mounted on present aircraft of the type The airframe dimensions are well-adapted to the motor thrust capabilities, and the zero-load weight per seat is 10-20% less than that of comparable aircraft P T H

A76-11166 **International Council of the Aeronautical Sciences, Congress, 9th, Haifa, Israel, August 25-30, 1974, Proceedings Volume 1 - Fluid Dynamics, Aerodynamics and Gas Dynamics Volume 2 - Structures, Materials, Dynamics, Propulsion, Design, Noise and Pollution** Congress sponsored by the Israel Society of Aeronautics and Astronautics, Technion - Israel Institute of Technology, and Israel Academy of Sciences and Humanities Edited by R R Dexter and J Singer (Technion - Israel Institute of Technology, Haifa, Israel) Jerusalem, Weizmann Science Press of Israel, 1974 Vol 1, 465 p , vol 2, 367 p Price of two volumes, $45

Papers are presented dealing with theoretical and experimental aerodynamics, materials for aircraft structures, aircraft design, aircraft propulsion, and aircraft noise and pollution problems Some of the topics covered include viscous effects in transonic flow past airfoils, numerical computations of wake vortices behind lifting surfaces, determination of ice deposition on slender wings, advanced material applications to subsonic transport aviation, automation of aircraft design process, and a study of the Concorde air intake in yaw P T H

A76-11228 # **Nonlinear relay model for post-stall oscillations** A L Schoenstadt (U S Naval Postgraduate School, Monterey, Calif) *Journal of Aircraft,* vol 12, July 1975, p 572-577 Navy-supported research

This paper considers an analytic treatment of divergent oscillations in the post-stall region for a general class of aircraft A limited, numerical investigation, on a single aircraft, has shown that a sufficiently large negative lift slope can lead to these oscillations Our investigation models the post-stall behavior in a general class of aircraft, under the hypothesis that, if the slope of the lift curve is sufficiently negative then the aircraft will see an essentially instantaneous loss of lift, which can be modeled by the introduction of a hypothetical relay Linearity assumptions on the other terms, together with conditions on the magnitude of various coefficients, lead to a system of coupled, constant coefficient, first-order, differential equations, with a forcing term characterized by a jump discontinuity Analysis of this system yields a necessary and sufficient condition for the existence of a limit cycle, and transcendental equations predicting the period of this cycle These conditions give predictions in excellent agreement with the results of the numerical investigation (Author)

A76-11229 # **Estimation of velocities and roll-up in aircraft vortex wakes.** A J Bilanin and C Donaldson (Aeronautical Research Associates of Princeton, Inc , Princeton, N J) *Journal of Aircraft,* vol 12, July 1975, p 578-585 27 refs Contract No F33615-73-C-3138

A nonlinear model is developed which determines the swirling and axial velocities in an aircraft vortex wake, given wing lift and drag distributions. The model is shown to reduce to that given by Betz when the axial velocity is the freestream value The nonlinear interaction of swirling and axial velocities may lead to velocity distributions which are different from those previously calculated Qualitatively, drag reduces the axial velocity in the vortex and results in an enlarged vortex radius and, therefore, a reduction in swirl velocity The inviscid model that predicts significant changes in the structure of the vortex wake, brought about solely by modification of the drag distribution, may require prohibitively large drag penalties Theoretical results compare favorably with measurements made by Orloff and Grant A model is developed to estimate the time to roll up a two-dimensional vortex sheet. Results are presented for the cases of linear, parabolic, and elliptic wing loading (Author)

A76-11230 # **Airplane engine selection by optimization on surface fit approximations** M J Healy (Boeing Computer Services, Inc, Seattle, Wash), J S Kowalik (Washington State University, Pullman, Wash), and J W Ramsay (Boeing Commercial Airplane Co, Seattle, Wash) *Journal of Aircraft,* vol 12, July 1975, p 593-599 12 refs Contract No F33615-73-C-2084

A comprehensive engine/airframe screening methodology has been developed based on surface fitting and nonlinear optimization procedures These procedures include the use of experimental design techniques, and a gradient-based method for nonlinear constrained minimization The methodology has been programmed for use on the CDC 6600 computer and has been successfully demonstrated on extensive test cases One test case involved selection of an optimum airplane design using performance data for only 28 designs. A total of 256 designs were required to locate this optimum graphically (Author)

A76-11233 * # **Propulsive effects due to flight through turbulence** W H Phillips (NASA, Langley Research Center, Flight Dynamics Control Div, Hampton, Va) *Journal of Aircraft,* vol 12, July 1975, p 624-626

A simple and straightforward analysis is presented for evaluating the approximate magnitude of the propulsive effect for various types of airplane (soaring glider, light airplane, fighter, and transport) The airplane, subject to vertical gust disturbances, is assumed to be constrained to fly at constant airspeed and constant pitch angle Changes in the magnitude and direction of the lift vector are taken into account It is shown that the thrust effects due to turbulence vary as the square of the turbulence intensity and are quite small for moderate turbulence Only for rather severe turbulence are the effects large enough to be given any consideration The thrust coefficient is 10-20% of the drag coefficient of a soaring glider S D

A76-11540 # **Generalized similarity laws for flows past three-dimensional bodies (*Obobshchennye zakony podobiia pri obtekanii prostranstvennykh tel*)** A I Bunimovich and A V Dubinskii *Prikladnaia Matematika i Mekhanika,* vol 39, July-Aug 1975, p 739-742 5 refs In Russian

For the case where the momentum flux at the surface of the body depends essentially on the local angle between the normal to the surface and the direction of the flow (as in case of hypersonic gas flow in a Newtonian formulation, or the flow of a rarefied gas), it is shown how generalized similarity laws can be established which relate the aerodynamic characteristics of three-dimensional affine-dissimilar bodies situated in various gas flows (e g , a Newtonian flow or a free-molecular flow of a rarefied gas) Methods of forming the respective bodies are proposed The application of the similarity laws is demonstrated by examples V P

A76-11569 **S-glass-reinforced plastic adopted for helicopter rotor blades** R D Holmes (General Dynamics Corp , San Diego, Calif) *(Society for the Advancement of Material and Process Engineering, Symposium, San Diego, Calif , Apr 28-30, 1975) SAMPE Quarterly,* vol 7, Oct 1975, p 28-41

It is noted that helicopter rotor blades are being fabricated from S-glass-reinforced plastic Investigations that led to the selection and use of this material are discussed, including a review of impact, fatigue, static, and exposure testing of materials and full-scale components Blade design features and fabrication methods are examined (Author)

A76-11570 **Building the B-1 graphite/epoxy slat** E E House (Lockheed-Georgia Co , Marietta, Ga) *SAMPE Quarterly,* vol 7, Oct. 1975, p 42-46

Three advanced composite slats built for the Air Force B-1 bomber are described Attention is given to the configuration of the baseline slat, questions of material selection, a fabrication overview, the elastomeric molding process, aspects of leading edge fabrication, and the eyebrow panel section The application of filler material and adhesive is discussed G R

A76-11621 **Trailing vortex wakes /First Society Anglo-Dutch Exchange Lecture/** G H Lee (British Airways, London, England) *Aeronautical Journal,* vol 79, Sept 1975, p 377-388 6 refs

Vortex wakes trailing behind large aircraft can induce roll moments on smaller aircraft entering the wake, and cause the latter to lose control Serious airport accidents have resulted from this Wakes can also damage airport buildings Increasing standoff distance between aircraft as a safety measure reduces runway capacity The article studies the growth and behavior of vortex wakes as dynamic systems, and concentrates on vortex attenuation methods Ratios of weight, size, and wing span of the leading and following aircraft are important The trailing wake can be safely penetrated by following aircraft up to a certain distance Best results are obtained by vortex attenuation using wingtip-mounted spoilers or vortex generators to break up the trailing wake, and only larger aircraft will need to have these vortex tamers built in or retrofitted R D V

A76-11622 **Technology research at Boeing Vertol Company** W E Hooper (Boeing Vertol Co, Philadelphia, Pa) *Aeronautical Journal,* vol 79, Sept 1975, p 389-400 10 refs

The article reviews recent advances in helicopter design and technology Blade twist, reduction of profile drag, and design of pendulum absorbers for vibration control are discussed as rotor design factors The dynamics of tail-rotor interaction, the effect of main rotor wake on tail rotor vortices, and internal noise simulation tests are described Fly-by-wire controls studies leading to the triplex electrical linkage system of the Heavy Lift Helicopter are described and system advantages are pointed out Tangential byproducts of helicopter design progress include windmill blade studies aided by helicopter rotor blade design technology, and improved detection of forest fires facilitated by results of studies aimed at reducing helicopter military vulnerability through suppressing the infrared signature of helicopters in flight B D V

A76-11623 **Helicopter development at Boeing Vertol Company** K I Grina (Boeing Vertol Co, Philadelphia, Pa) *Aeronautical Journal,* vol 79, Sept 1975, p 401-416

Three development programs are reviewed the Chinook generation medium-lift helicopters, the Utility Tactical Transport Air System (UTTAS), and HLH (Heavy Lift Helicopter) Rotor blades, cargo handling, hub controls, and the honeycomb sandwich fuselage of HLH are described Advantages of fiberglass rotor blades over metal rotor blades are studied, with a discussion of defect tolerant design philosophy R D V

A76-11660 **The CCV concept (Le concept CCV)** J -C Wanner (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *L'Aéronautique et l'Astronautique,* no 54, 1975, p 7-15 In French

The Control Configured Vehicle concept is defined as an aircraft optimal design approach in which full reliance on modern electronic control techniques is assumed so that the usual constraints imposed by requirements of flight stability, structural stability, service life, and crew and passenger comfort can be ignored while designing aerodynamically optimal airframes A qualitative evaluation of some of the basic control techniques available is given, including artificial stability systems, antiflutter systems, antiturbulence systems, and systems for countering direct and maneuvering loads Gains and losses in comparison with classical mechanical controls are discussed P T H

A76-11663 **The evolution of turbojet control systems (Evolution des systèmes de régulation des turboréacteurs)** A Barbot (SNECMA, Moissy-Cramayel, Seine-et-Marne, Centre de Documentation de l'Armement, Paris, France) *L'Aéronautique et l'Astronautique,* no 54, 1975, p 33-38 In French

The paper examines some schemes for electronic and hybrid hydroelectronic control of turbojet engine regime and temperature and discusses them with respect to performance, safety, and weight The basic problem in design of control systems is that increased performance is obtainable with electronic controls, but reliability factors must be taken into account Schemes with electronic control and hydromechanical back-up, or redundant electronic systems are possible Systems with computer featuring test and self-test capability will obtain even greater reliability P T H

A76-11664 **Experimental study of a supersonic blade array with small deflection angle (Etude expérimentale d'une grille d'aubes supersonique à faible déflexion)** H Miton, P Duport, and A Agnes (Aix-Marseille, Université, Marseille, France) *L'Aéronautique et l'Astronautique,* no 54, 1975, p 39-43 In French

A facility for testing planar blade arrays used in supersonic compressors is described Appropriate regulating devices permit control of the two-dimensionality and periodicity of the flow through the array Some preliminary test results are given P T H

A76-11665 **Military cargo aircraft of the AMST program (Cargos militaires du programme AMST)** G Bruner (Centre de Documentation de l'Armement, Paris, France) *L'Aéronautique et l'Astronautique,* no 54, 1975, p 45-56 In French

Following a recall of the specifications and of the historical background of the American AMST program for a military STOL cargo aircraft, the basic blowing process for ensuring the required lift augmentation is presented as regards the two projects now under consideration, namely the Boeing YC-14 and the McDonnell-Douglas YC-15 The aircraft (wing, fuselage, tail, landing gear, propulsion unit, equipment) is then described, some detailed information on the efficiency of the high lift devices are given, the expected performance is indicated, and some hints on project advancement stage and on the effort developed in view of lowering the production aircraft cost are given (Author)

A76-11771 **Flap-lag stability of helicopter rotor blades in forward flight** D A Peters (Washington University, St Louis, Mo) *American Helicopter Society, Journal,* vol 20, Oct 1975, p 2-13 10 refs

The linearized stability characteristics of rotor blades in forward flight are examined Equations of motion are derived for the case of a centrally hinged spring restrained rigid blade Various commonly used approximations for the equations of motion are examined in order to determine their effect on stability calculations These comparisons show that periodic coefficients are important for flap-lag stability even at low advance ratios The effect of rotor equilibrium on blade stability is studied It is found that the variation in rotor trim and inflow with forward speed has a significant effect on blade stability Finally, rotor stability boundaries are presented for a variety of rotor parameters showing that forward flight can often change the qualitative effects of certain parameters on blade stability (Author)

A76-11772 **Some conclusions from an investigation of blade-vortex interaction** N D Ham (MIT, Cambridge, Mass) *American Helicopter Society, Journal,* vol 20, Oct 1975, p 26-31 21 refs Army-sponsored research

Blade-vortex interaction was investigated by subjecting the mid-section of a pressure-instrumented airfoil, mounted horizontally and perpendicular to the wind-tunnel air stream, to the impingement of a vortex moving periodically in the vertical plane The results show that the maximum induced lift coefficients are of the order 0 2 to 0 3, and the induced peak loadings were found to be independent of the frequency of impingement and proportional to vortex strength The results have important implications with respect to the unsteady loading on helicopter rotor blades B J

A76-11868 # **Influence of the initial values on the camber, twist, planform, and wave-drag coefficient of the absolutely optimum thin-section delta wing in supersonic flow (Einfluss der Anfangswerte auf die Wolbung, Verwindung, Grundrissform und Wellenwiderstandsbeiwert des Optimum-optimorum dunnen Deltaflugels in Überschallstromung)** A Nastase (Rheinisch-Westfalische Technische Hochschule, Aachen, West Germany) *Rheinisch-Westfalische Technische Hochschule, Aerodynamisches Institut, Abhandlungen,* no 22, 1975, p 121-125 14 refs In German

A76-11870 # **Flows around accelerated, slender bodies for M less than, equal to, and greater than 1 (Strömungen um beschleunigte, schlanke Körper fur M less than, equal to, and greater than 1)** J Ballmann (Rheinisch-Westfalische Technische Hochschule, Aachen, West Germany) *Rheinisch-Westfalische Technische Hochschule, Aerodynamisches Institut, Abhandlungen,* no 22, 1975, p 134-139 10 refs In German

Attention is given to a slender body which is in a state of motion within a gas that is initially at rest However, the moving body produces a motion in the gas within an area which increases with time The resulting velocity field is considered The history of the motion of a point which is fixed with respect to the body is examined, taking into account the motion of this point in relation to an arbitrary point, fixed in space, on the trajectory of the body An approach employing singularities is discussed for the calculation of the linearized unsteady potential flow around slender bodies, giving attention to a method reported by Ballmann (1969) G R

A76-11875 # **Aeroacoustic research at the UT Space Institute, Tullahoma, Tennessee on slot nozzles without and with shrouds.** B H Goethert (Tennessee, University, Tullahoma, Tenn) *(Rheinisch-Westfalische Technische Hochschule, Aerodynamisches Institut, Abhandlungen,* no 22, 1975, p. 210-220 5 refs U S Department of Transportation Contract No FA72WA-3053.

Aeroacoustical investigations have been conducted on STOL configurations at static thrust conditions Analytic and experimental studies of exhaust jet noise generated by slot nozzles with and without flaps, and by shrouded nozzles are described It has been shown that effective shielding of the exhaust noise can be accomplished by relatively long flaps, that the addition of short flaps substantially increases the exhaust noise in comparison to slot nozzles without flaps, and that placing a shroud with attenuating lining over the exhaust of a slot nozzle and providing for the insertion of secondary air can lead to substantial jet noise reductions B J

A76-11893 # **W Kasprzyk airfoil - The first wind-tunnel tests (Skrzydlo W Kasprzyka - Wstepne badania tunelowe).** T Wusatowski *Technika Lotnicza i Astronautyczna,* vol 30, Sept 1975, p 9, 10 In Polish

The Kasprzyk slotted-flap glider airfoil (the Kasper wing) enabling glider flight at 32 km/h and 0 5 m/sec descent speed was wind-tunnel-tested in the U S The test layout is described and reasons offered for discrepancies between wind-tunnel results and Polish in-flight data high induced drag caused by relative size of model wing span and tunnel, by vortex attenuators on the model and their proximity to the tunnel wall, nonsimilarity between flow over a smooth wing and flow over the Kasprzyk wing with bound vortices, obstruction of the tunnel test chamber cross section by the model wing, discrepant Reynolds numbers, and model airfoil aspect ratio much smaller than the prototype The overall results offer partial confirmation of the Kasprzyk theory, but further in-tunnel and in-flight studies are recommended R D V

A76-11894 # **Compatibility analysis of turbojet engine and engine intake (Analiza zgodnosci wspolpracy turbinowego silnika odrzutowego z jego wlotem)** T Gajewski *Technika Lotnicza i Astronautyczna,* vol 30, Sept 1975, p 14-16 In Polish

The ratio of compressor inlet stagnation pressure to stagnation pressure in the undisturbed stream is adopted as the principal criterion of stream energy losses, but this ratio is in turn affected by the compatibility of the turbine engine and its inlet duct The compatibility of the turbine engine and exhaust nozzle, of the turbine and compressor, and of the turbine engine and intake are affected by differences and tolerances at the manufacturing end, and differ in redesign and retrofit variants The method of finite increments and a linearization procedure are applied to the problem, and computational criteria and graphs are constructed R D V

A76-11895 # **Some reasons for crack formation in afterburner chamber shells (Niektore przyczyny powstawania pekniec powloki komory dopalacza)** J Borgon and M Ostapkowicz. *Technika Lotnicza i Astronautyczna,* vol 30, Sept 1975, p 23, 24 5 refs In Polish

High thermal stresses and structural flaws are reviewed as causes of cracking in afterburner shells under different sets of operating conditions The response of heat-conductive materials to potential hot spots and thermal shock, and variation of heat flow and thermal stresses with afterburner shell thickness, are examined in relation to migration of dislocations, phase segregation, slip, stressed state, oxide films, microasperities and micro-inclusions, etch pits, and precipitations The effect of pressure pulsations and pressure drops, uneven fuel injection, improper burning and mixing on fatigue and buckling of shells is reviewed, as well as design measures to avert cracking and buckling under mechanical load at elevated temperatures R D V

A76-11897 # **Hanging gliders - Theory and practice I (Lotnie - Teoria i praktyka I)** *Technika Lotnicza i Astronautyczna,* vol 30, Oct 1975, p 8 11 In Polish

The paper gives an overview of some of the main aspects of hanging glider mechanics, aerodynamics, and construction, describing takeoff, landing, and flight at low speeds, and prescribing structural parameters Turning flight is described in detail, giving special attention to the effects of changes in the distribution of lift forces and load as a result of gusts during turning P T H

A76-11898 # **Probabilistic evaluation of safe landing for a transport aircraft (Probabilistyczna ocena bezpiecznego ladowania samolotu komunikacyinego)** T Buczylko *Technika Lotnicza i Astronautyczna,* vol 30, Oct 1975, p 19-22 11 refs In Polish

Flight and landing of a transport aircraft are analyzed as a stochastic process Safe landing probabilities are calculated on the basis of the probabilities of dangerous random events. Polish, British, French, and ICAO norms regarding safe landing probabilities are examined P T H

A76-11972 # **Aerodynamic design consideration for maneuverability** P J Butkewicz (U S Department of Defense, Washington, D.C) and R A Crawford (USAF, Institute of Technology, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and U S Air Force, Mini-Symposium on Recent Advances in Aeronautical Research Technology and Systems, Wright-Patterson AFB, Ohio, Mar 26, 1975, Paper* 16 p

Air combat effectiveness is influenced primarily by maneuverability, persistence, target and threat detection, weapons effectiveness, and tactics Aircraft maneuverability and persistence are determined by airframe aerodynamics, installed propulsion, stability and control, and structural efficiency The importance of combat wing loading and thrust to weight ratio are reviewed with respect to advanced aerodynamic technology A reduction in wing loading essential to high maneuverability provides large technology advances when combined with variable camber, vortex flow control, and wing body blending Future trends in maneuvering aerodynamics will be toward higher cruising and combat speeds while preserving present levels of agility (Author)

A76-12154 # **Systems engineering and air transport (La ingeniería de sistemas y el transporte aéreo)** M Abejon Adamez *IAA/Ingeniería Aeronáutica y Astronáutica,* vol 27, Aug Sept 1975, p 7-20 42 refs In Spanish

The system concept is examined along with a number of aspects of systems engineering The large social, technical, and economic systems and organizations of contemporary life are considered An investigation is conducted concerning questions of systems engineering in the field of transportation and a description is given of the characteristics of air transport from the point of view of systems engineering The character of the airport as an interphase between air transport and land transportation is discussed and the technological, economical, and organizational problems of transport integration are studied G R

A76-12156 # **The safety of flight operations (Seguridad de las operaciones en vuelo)** R Fernandez *IAA/Ingeniería Aeronáutica y Astronáutica,* vol 27, Aug -Sept 1975, p 57-72 In Spanish

Aircraft accidents and their causes are examined and typical operational problems are investigated Approach and landing operations are considered, taking into account the ultimate operational phase, approach procedures designed to reduce noise, details of landing procedures, wind effects, and effects produced by water, snow, ice, mud, and residue of oil on the runway Other types of accidents are related to different forms of turbulence in connection with thunderstorms, air currents near mountains, clear-air turbulence, and flow effects in the wake of a preceding aircraft Collision-related accidents are also discussed and attention is given to cases in which the human factor must be held responsible for the accident G R

A76-12159 **Airline profit pinch clouds harvest of gains** W H Gregory *Aviation Week and Space Technology,* vol 103, Nov 10, 1975, p 32-34, 39, 41

It is pointed out that enough new technology is at hand or clearly on the horizon to build a more economic, lower fuel consumption commercial transport However, because of economic factors partly related to inflation it is uncertain whether and when such a transport will be developed It is found that airlines and transport aircraft manufacturers are more sensitive to violent inflation than other industries Attention is given to new technological developments and the prospects for the incorporation of these developments in the next-generation aircraft G R

A76-12160 **Builders vie for short/medium market** D E Fink *Aviation Week and Space Technology,* vol 103, Nov 10, 1975, p 43-45, 51, 52

American aerospace companies agree that there is a need for a 180-200 passenger aircraft with operating economics which meet the requirements of the 1980s However, the design approach concerning such an aircraft differs for each company The merits of the various approaches are discussed, taking into account questions of fuel economy and flight characteristics Attention is given to tunnel tests, aspects of ramp compatibility, and noise requirements G R

A76-12161 **Short-haul designs include trade-offs.** B M Elson *Aviation Week and Space Technology,* vol 103, Nov 10, 1975, p 73, 75, 77, 78

Research is conducted to develop the technological options that will permit a wide range of trade-offs among cost, performance, traffic, and environmental factors in the design of short-haul transports for the 1980s and beyond The work involves a combination of analysis, simulation, wind tunnel tests, and flight tests The characteristics of research aircraft for the investigations are discussed Attention is given to developments concerning the design of aircraft propellers, fuel-saving measures, and active controls programs G R

A76-12285 # **Optimum design of axial flow fans with cambered blades of constant thickness** M Blaho (Budapesti Muszaki Egyetem, Budapest, Hungary) *Periodica Polytechnica, Mechanical Engineering,* vol 19, no 2, 1975, p 79-89

An investigation is conducted of the losses of cascades in conjunction with the outlet losses Particular attention is given to cambered blades, which are most frequently employed in fans Questions of optimum camber design are examined and the correlation between optimum lift to drag ratio and cascade density is considered The variation of the optimum lift to drag ratio as a function of the approach angle is also discussed along with the losses in axial flow fans A description of the calculation of force factors in cascades is provided in an appendix G R

A76-12300 **Towards hypersonics** *Flight International,* vol 108, Oct 30, 1975, p 657, 658

Continuing NASA and USAF research on flight at M4 to M12, is reviewed Operational hypersonic vehicles might appear in a leap frogging advance over their supersonic counterparts The blended-wing X-24C air-launched lifting body is useful as a versatile flying test bed Turboramjets and supersonic combustion ramjets (scramjets) are considered as M5 powerplants (two set of powerplants, at best structurally integrated, will be required for practical operation) Hypersonic aerokinetic heating and ways of designing against it (refractory skin, ablative heat-sink insulation, active cooling with cryogenic fuels) are discussed R D V

A76-12399 # **Some general questions concerning the vibrations of launch vehicles III - High-frequency vibrations (Quelques questions générales concernant les vibrations des lanceurs III - Vibrations à haute fréquence)** J Lacaze (Agence Spatiale Europeenne, Division Ariane, Paris, France) *ESA Scientific and Technical Review,* vol 1, no 1, 1975, p 35-66 20 refs In French

The response of a wall exposed to a random acoustic field is examined as a function of the level, the spectrum, and spatial correlation of the noise The transmission of vibrations between various media, acoustic volumes, and walls is studied by using the Statistical Energy Analysis (SEA) method These studies yield conclusions regarding the behavior of launcher and satellite equipments P T H

A76-12486 # **Simulation study of aircraft handling during engine failure (Issledovanie pilotirovaniia samoleta pri otkaze dvigatelia na modeliruiushchem stende)** A V Polukhin, A M Fal', and V A Bimbas (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR) In Ergonomic dynamic control systems Kiev, Izdatel'stvo Naukova Dumka, 1975, p 150-154 5 refs In Russian

The effect of a failure of one of the turboprop engines of the IL-18 aircraft on its handling characteristics is studied Some criteria are introduced which allow estimation of handling criteria when an outer engine has failed Simulation results are given which show the effect of the time taken by the pilot to detect the engine failure on the process of parrying the dangerous angular variations of the aircraft P T H

A76-12487 # **Universal system for loading the control elements of flight simulators (Universal'naia sistema zagruzhi organov upravleniia dlia imitatorov poleta)** V A Vasilenko and V Iu Dmitriev (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR) In Ergonomic dynamic control systems Kiev, Izdatel'stvo Naukova Dumka, 1975, p 154-156 In Russian

The paper describes briefly a setup for loading the control elements of flight simulators and trainers in order to reproduce the forces on the control elements, the displacement range of the control elements of the simulated aircraft, the effect of trimming, and nonlinearity in the aircraft control system The chief unit in the loading system is an asynchronous motor with hollow rotor The system is applicable for simulating aircraft with direct, reversible power-assisted, or irreversible power-assisted control P T H

A76-12498 **The asset management approach to spares support** M D Basch (Federal Express Corp, Memphis, Tenn) *Logistics Spectrum,* vol 9, Fall 1975, p 37-39, 42

A program of asset management applicable to commercial aircraft spare parts support is discussed which achieves required service levels at reduced costs through integration of inventory, transportation, and warehousing The program involves implementation of centralized back up support, objective forecasting and planning, and a positive inventory control system A practical model for determining the least costs sparing levels on a national or local basis is presented C K D

A76-12500 **The airship - Phoenix or Dodo** F J Regan (U S Navy, Naval Surface Weapons Center, Silver Spring, Md) *Machine Design,* vol 47, Nov 13, 1975, p 20-22, 24

A new lease on life for airships, in the form of hybrids with fixed-wing and rotary-wing heavier-than-air craft, is considered in terms of engineering feasibility and economic competitiveness Drone aerostats for nonmilitary monitoring and surveillance, 1000-T heavy-lift balloon-helicopter cranes, fixed-wing four-jet dirigibles, aerostat-helicopter hybrids, heavy-duty hybrids might compete with jumbo-jet freighters and supertankers in transporting large indivisible loads Techniques not available in the 30s that could render such concepts workable include computer stress analysis, vectored thrust and high lift, high-strength composites, computer flight control and trim adjustment, variable and tiltable control surfaces R D V

A76-12516 **The present outlook for aerostatic techniques (Perspectives actuelles des techniques aérostatiques)** P Contensou (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *Sciences et Techniques,* Oct 15, 1975, p 21-24 In French

A historical overview of the relative advances and lags in the development, use, and acceptance of aerostats and various types of aerodynes (gliders, fixed-wing aircraft, rotary-wing aircraft) focuses on the coefficient of friction (of the vehicle against the supporting, buoyant, or resisting medium) and on various extra-technical factors (cost, congestion, noise, total energy and fuel consumption, energy and fuel consumption per unit payload, public attitudes toward technical progress) that might offer aerostatic vehicles a change at a comeback Conveying heavy and cumbersome bulk freight, where short travel time and fast speed are not essential factors, is seen as promising for economic use of aerostats, while control and maneuverability in docking and cruise are viewed as the major problems, given recent advances in materials science and design computation techniques R D V

STAR ENTRIES

N76-10002*# Massachusetts Inst of Tech Cambridge Measurement Systems Lab
A PASSIVE GUST ALLEVIATION SYSTEM FOR A LIGHT AIRCRAFT Final Report
Phillippe Roesch and Raymond B Harlan Washington NASA Oct 1975 136 p refs
(Grant NGR-22-009-782)
(NASA-CR-2605 RE-90) Avail NTIS HC $5 75 CSCL 01C

A passive aeromechanical gust alleviation system was examined for application to a Cessna 172 The system employs small auxiliary wings to sense changes in angle of attack and to drive the wing flaps to compensate the resulting incremental lift The flaps also can be spring loaded to neutralize the effects of variations in dynamic pressure Conditions for gust alleviation are developed and shown to introduce marginal stability if both vertical and horizontal gusts are compensated Satisfactory behavior is realized if only vertical gusts are absorbed however elevator control is effectively negated by the system Techniques to couple the elevator and flaps are demonstrated to restore full controllability without sacrifice of gust alleviation Author

N76 10004*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
POPPET VALVE CONTROL OF THROAT STABILITY BYPASS TO INCREASE STABLE AIRFLOW RANGE OF A MACH 2 5 INLET WITH 60 PERCENT INTERNAL CONTRACTION
Glenn A Mitchell and Bobby W Sanders Washington Oct 1975 49 p refs
(NASA-TM-X-3297 E-8382) Avail NTIS HC $3 75 CSCL 20D

The throat of a Mach 2 5 inlet with a coldpipe termination was fitted with a stability-bypass system System variations included several stability bypass entrance configurations Poppet valves controlled the bypass airflow The inlet stable airflow range achieved with each configuration was determined for both steady state conditions and internal pulse transients Results are compared with those obtained without a stability bypass system Transient results were also obtained for the inlet with a choke point at the diffuser exit and for the inlet with large and small stability bypass plenum volumes Poppet valves at the stability bypass exit provided the inlet with a stable airflow range of 20 percent or greater at all static and transient conditions Author

N76-10005*# United Technologies Research Center East Hartford Conn
TRANSIENT AIRLOAD COMPUTER ANALYSIS FOR SIMULATING WIND INDUCED IMPULSIVE NOISE CONDITIONS OF A HOVERING HELICOPTER ROTOR
Gerald F Hall Oct 1975 48 p refs Sponsored in part by Army Air Mobility R and D Lab Moffett Field Calif
(Contract NAS2-7025)
(NASA-CR-137772) Avail NTIS HC $3 75 CSCL 01A

A numerical analysis was developed to determine the airloads on helicopter rotors operating under near-hovering flight conditions capable of producing impulsive noise A computer program was written in which the solutions for the rotor tip vortex geometry inflow aeroelastic response and airloads are solved in a coupled manner at sequential time steps with or without the influence of an imposed steady ambient wind or transient gust The program was developed for future applications in which predicted airloads would be incorporated in an acoustics analysis to attempt to predict and analyze impulsive noise (blade slap) The analysis was applied to a hovering full scale rotor for which impulsive noise was recorded in the presence of ambient wind The predicted tip vortex coordinates are in reasonable agreement with the test data and the blade airload solutions converged to a periodic behavior for an imposed steady ambient wind conditions Author

N76-10006*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EFFECTS OF JET EXHAUST GAS PROPERTIES ON EXHAUST SIMULATION AND AFTERBODY DRAG
William B Compton III Washington Oct 1975 128 p refs
(NASA-TR-R-444 L-10183) Avail NTIS HC $5 75 CSCL 01A

The effect of varying the jet exhaust s ratio of specific heats gas constant and temperature on airplane afterbody drag was investigated Jet exhaust simulation parameters were evaluated also Subsonic and transonic tests were made using a single nacelle model with afterbodies having boattail angles of 10 deg and 20 deg Besides air three other jet exhaust gases were investigated The ratios of specific heats gas constants and total temperatures of the four exhaust gases ranged from 1 40 to 1 26 287 to 376 J/kg-K and 300 to 1013 K respectively For steep boattail angles and transonic speeds and typical turbojet pressure ratios the current data indicate that the use of air to simulate a dry turbojet exhaust can result in an overprediction of afterbody drag as high as 17 percent of the dry turbojet value Author

N76-10007*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
AERODYNAMIC ANALYSES REQUIRING ADVANCED COMPUTERS, PART 1
Washington 1975 710 p refs Conf held at Hampton Va 4-6 Mar 1975
(NASA-SP-347-Pt-1) Avail NTIS HC $17 25 CSCL 09B

Papers are presented which deal with results of theoretical research on aerodynamic flow problems requiring the use of advanced computers Topics discussed include viscous flows boundary layer equations turbulence modeling and Navier-Stokes equations and internal flows

N76-10010* Douglas Aircraft Co Inc El Segundo Calif
CALCULATION OF THREE-DIMENSIONAL COMPRESSIBLE LAMINAR AND TURBULENT BOUNDARY LAYERS CALCULATION OF THREE-DIMENSIONAL COMPRESSIBLE BOUNDARY LAYERS ON ARBITRARY WINGS
Tuncer Cebeci Kalle Kaups Judy Ramsey and Alfred Moser *In* NASA Langley Res Center Aerodynamic Analyses Requiring Advanced Computers Pt 1 1975 p 41-76 refs

CSCL 01A

A very general method for calculating compressible three-dimensional laminar and turbulent boundary layers on arbitrary wings is described The method utilizes a nonorthogonal coordinate system for the boundary-layer calculations and includes a geometry package that represents the wing analytically In the calculations all the geometric parameters of the coordinate system are accounted for The Reynolds shear-stress terms are modeled by an eddy-viscosity formulation developed by Cebeci The governing equations are solved by a very efficient two-point finite-difference method used earlier by Keller and Cebeci for two-dimensional flows and later by Cebeci for three-dimensional flows Author

N76-10015* Grumman Aerospace Corp Bethpage, N Y
ASYMPTOTIC THEORY OF TWO-DIMENSIONAL TRAILING-EDGE FLOWS
R E Melnik and R Chow *In* NASA Langley Res Center Aerodynamic Analysis Requiring Advanced Computers, Pt 1 1975 p 177-249 refs
(Contract NAS1-12426)
CSCL 20D

Problems of laminar and turbulent viscous interaction near trailing edges of streamlined bodies are considered Asymptotic expansions of the Navier-Stokes equations in the limit of large Reynolds numbers are used to describe the local solution near the trailing edge of cusped or nearly cusped airfoils at small angles of attack in compressible flow A complicated inverse iterative procedure, involving finite-difference solutions of the triple-deck equations coupled with asymptotic solutions of the boundary values, is used to accurately solve the viscous interaction problem Results are given for the correction to the boundary-layer solution for drag of a finite flat plate at zero angle of attack and for the viscous correction to the lift of an airfoil at incidence A rational asymptotic theory is developed for treating turbulent interactions near trailing edges and is shown to lead to a multilayer structure of turbulent boundary layers The flow over most of the boundary layer is described by a Lighthill model of inviscid rotational flow The main features of the model are discussed and a sample solution for the skin friction is obtained and compared with the data of Schubauer and Klebanoff for a turbulent flow in a moderately large adverse pressure gradient
Author

N76-10021* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
SIMULATION OF TURBULENT TRANSONIC SEPARATED FLOW OVER AN AIRFOIL
George S Deiwert John B McDevitt and Lionel L Levy Jr *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 1 1975 p 419-436 refs
01-02)
CSCL 20D

A code developed for simulating high Reynolds number transonic flow fields of arbitrary configuration is described This code in conjunction with laboratory experiments is used to devise and test turbulence transport models which may be suitable in the prediction of such flow fields, with particular emphasis on regions of flow separation The solutions describe the flow field including both the shock-induced and trailing-edge separation regions in sufficient detail to provide the profile and friction drag
Author

N76-10023* Mississippi State Univ, Mississippi State
NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR ARBITRARY TWO-DIMENSIONAL AIRFOILS
Frank C Thames Joe F Thompson and C Wayne Mastin *In* NASA Langley Res Center Aerodynamic Analyses Requiring Advanced Computers Pt 1 1975 p 469-530 refs

(Grant NGR-25-001-055)
CSCL 20D

A method for numerical solution of the Navier-Stokes equations for the flow about arbitrary airfoils or other bodies is presented This method utilizes a numerically generated curvilinear coordinate system having a coordinate line coincident with the body contour Streamlines velocity profiles and pressure and force coefficients for several airfoils and an arbitrary rock are given Potential flow solutions are also presented The procedure capable of treating multiple-element airfoils and potential flow results are presented
Author

N76-10026* Massachusetts Inst of Tech Cambridge
COMPUTATIONAL ASPECTS OF THE PREDICTION OF MULTIDIMENSIONAL TRANSONIC FLOWS IN TURBOMACHINERY
David A Oliver and Panagiotis Sparis *In* NASA Langley Res Center Aerodynamic Analyses Requiring Advanced Computers, Pt 1 1975 p 567-585 refs

CSCL 20D

The analytical prediction and description of transonic flow in turbomachinery is complicated by three fundamental effects (1) the fluid equations describing the transonic regime are inherently nonlinear (2) shock waves may be present in the flow, and (3) turbomachine blading is geometrically complex possessing large amounts of curvature stagger, and twist A three-dimensional computation procedure for the study of transonic turbomachine fluid mechanics is described The fluid differential equations and corresponding difference operators are presented the boundary conditions for complex blade shapes are described and the computational implementation and mapping procedures are developed Illustrative results of a typical unthrottled transonic rotor are also presented
Author

N76-10027* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
TIME-DEPENDENT TRANSONIC FLOW SOLUTIONS FOR AXIAL TURBOMACHINERY
John Erdos (Advanced Technol Labs Inc) Edgar Alzner (Advanced Technol Labs Inc) Paul Kalben (Advanced Technol Labs Inc) William McNally and Simon Slutsky (Polytechnic Inst of New York) *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 1 1975 p 587-621 refs

CSCL 20D

Three-dimensional unsteady transonic flow through an axial turbomachine stage is described in terms of a pair of two-dimensional formulations pertaining to orthogonal surfaces namely a blade-to-blade surface and a hub-to-casing surface The resulting systems of nonlinear inviscid compressible equations of motion are solved by an explicit finite-difference technique The blade-to-blade program includes the periodic interaction between rotor and stator blade rows Treatment of the boundary conditions and of the blade slipstream motion by a characteristic type procedure is discussed in detail Harmonic analysis of the acoustic far field produced by the blade row interaction including an arbitrary initial transient is outlined Results from the blade-to-blade program are compared with experimental measurements of the rotating pressure field at the tip of a high-speed fan The hub-to-casing program determines circumferentially averaged flow properties on a meridional plane Blade row interactions are neglected in this formulation but the force distributions over the entire blade surface for both the rotor and stator are obtained Results from the hub-to-casing program are compared with a relaxation method solution for a subsonic rotor Results are also presented for a quiet fan stage which includes transonic flow in both the rotor and stator and a normal shock in the stator
Author

N76-10028* National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
A COMPARISON OF A SHOCK-CAPTURING TECHNIQUE WITH EXPERIMENTAL DATA FOR THREE-DIMENSIONAL INTERNAL FLOWS
Leroy L. Presley *In its* Aerodynamic Analyses Requiring Advanced Computers, Pt 1 1975 p 623-642 refs

CSCL 20D

Shock-capturing solutions for an axisymmetric supersonic inlet at small angles of attack are obtained Good overall agreement between the shock-capturing solutions and experimental data is shown except in regions of strong viscous effects or boundary-layer removal Although the results indicate a strong potential for the use of shock-capturing or finite-difference solutions for internal flows, improvement in the ability to handle the reflection of strong shockwaves having downstream Mach numbers near 1 is needed
Author

N76-10029* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

INTERNAL AND EXTERNAL AXIAL CORNER FLOWS

Paul Kutler Vijaya Shankar (Iowa State Univ of Sci and Technol), Dale A Anderson (Iowa State Univ of Sci and Technol) and Reese L Sorenson *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 1 1975 p 643-658 refs

CSCL 20D

The inviscid, internal and external axial corner flows generated by two intersecting wedges traveling supersonically are obtained by use of a second-order shock-capturing finite-difference approach The governing equations are solved iteratively in conical coordinates to yield the complicated wave structure of the internal corner and the simple peripheral shock of the external corner The numerical results for the internal flows compare favorably with existing experimental data Author

N76-10030* Advanced Technology Labs Inc, Westbury N Y

NUMERICAL METHODS FOR THE CALCULATION OF THREE-DIMENSIONAL NOZZLE EXHAUST FLOW FIELDS

Sanford M Dash and Paul D DelGuidice *In* NASA Langley Res Center Aerodynamic Analyses Requiring Advanced Computers Pt 1 1975 p 659-701 refs

(Contract NAS1-12726)

CSCL 20D

Numerical codes developed for the calculation of three-dimensional nozzle exhaust flow fields associated with hypersonic airbreathing aircraft are described Both codes employ reference plane grid networks with respect to three coordinate systems Program CHAR3D is a characteristic code utilizing a new wave preserving network within the reference planes, while program BIGMAC is a finite difference code utilizing conservation variables and a one-sided difference algorithm Secondary waves are numerically captured by both codes while the underexpansion shock and plume boundary are treated discretely The exhaust gas properties consist of hydrogen-air combustion product mixtures in local chemical equilibrium Nozzle contours are treated by a newly developed geometry package based on dual cubic splines Results are presented for simple configurations demonstrating two- and three-dimensional multiple wave interactions Author

N76-10032* National Aeronautics and Space Administration Langley Research Center, Langley Station Va

COMPUTERIZED PROCEDURES FOR AIRFOIL DESIGN

Raymond L Barger and Cuyler W Brooks Jr *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 703-712 refs

CSCL 01C

Several airfoil design procedures are described The first is a procedure for designing an airfoil shape to have a prescribed surface pressure distribution it is applicable to the design of supercritical as well as subcritical airfoils The second is a computerized procedure based on the Theodorsen epsilon-function design technique and is esentially incomdessible It also permits description of the pressure distribution with the additional feature of providing simple means for controlling important airfoil parameters The remainder of the discussion is concerned with the application of various techniques based on the epsilon-function theory to specialized design problems Author

N76-10033* National Aeronautics and Space Administration Langley Research Center Langley Station Va

A COMPUTER PROGRAM FOR THE ANALYSIS OF MULTIELEMENT AIRFOILS IN TWO-DIMENSIONAL SUBSONIC, VISCOUS FLOW

Harry L Morgan Jr *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 713-747 refs

CSCL 20D

A computerized analytical model which computes the performance characteristics of multielement airfoils in subsonic viscous flow was developed The model computes the viscous pressure distributions lift moments and local boundary-layer properties on each element of an arbitrarily arranged slotted airfoil in attached flow The final viscous solution was obtained by an iterative technique for successively combining an inviscid solution with boundary-layer displacement thicknesses The surface of each airfoil element is approximated as a closed polygon with segments represented by distributed vortex singularities The ordinary boundary-layer solution is comprised of mathematical models representing state-of-the-art technology for laminar transition and turbulent boundary layers An additional boundary-layer model was incorporated to compute the characteristics of a confluent boundary layer which reflects the merging of the upper-surface boundary layer with the slot efflux This computer program was used extensively for both the design and the analysis of airfoils Summary descriptions of the general operation and capabilities of this program and a detailed description of the major improvements that were made to the program since its initial formulation are presented Author

N76-10034* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

APPLICATION OF NUMERICAL OPTIMIZATION TECHNIQUES TO AIRFOIL DESIGN

Garret N VanDerPlaats Raymond N Hicks and Earll M Murman (Flow Res Inc Los Angeles) *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 749-768 refs

CSCL 20D

A practical procedure is presented for automated airfoil design using numerical optimization techniques The procedure uses an optimization program based on conjugate directions for locally unconstrained problems and feasible directions for locally constrained problems This program is coupled with an aerodynamic analysis program which uses a relaxation method to solve the partial differential equation that governs the inviscid small-disturbance fluid flow Basic optimization concepts and the techniques used in the optimization program are described and the procedure for automating airfoil design is outlined Design objectives which are considered include lift maximization drag minimization and pitching-moment minimization various aerodynamic and geometric constraints on the design are accounted for Design results are presented to demonstrate the simplicity and generality of the method Author

N76-10035* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

TSFOIL A COMPUTER CODE FOR TWO-DIMENSIONAL TRANSONIC CALCULATIONS, INCLUDING WIND-TUNNEL WALL EFFECTS AND WAVE-DRAG EVALUATION

Earll M Murman (Flow Res Inc, Los Angeles) Frank R Bailey and Margaret L Johnson (Computer Sci Corp) *In its* Aerodynamic Analysis Requiring Advanced Computers Pt 2 1975 p 769-788 refs

CSCL 20D

An up-to-date computer program to solve the transonic small-disturbance equation for two-dimensional flow past lifting airfoils was written The theoretical and numerical formulation of the code is outlined and several computed examples are included The user-oriented code is capable of computing both free-air flows and various wind-tunnel wall conditions Applications and limitations of the program are discussed Author

N76-10036* National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif

NUMERICAL INTEGRATION OF THE SMALL-DISTURBANCE POTENTIAL AND EULER EQUATIONS FOR UNSTEADY TRANSONIC FLOW

Richard M Beam and William F Ballhaus (Army Air Mobility R and D Lab) *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 789-809 refs

CSCL 20D

Two methods for solving unsteady nonlinear, transonic flow problems were investigated and compared One method is to solve the Euler equations by using an implicit numerical scheme to increase the integration time step while the second method uses semi-implicit scheme to solve the low-frequency, transonic small-disturbance potential equations Although the second method is more limited (small disturbance low frequency) than the first, it offers savings in computer time and storage requirements over the first method The details of the two methods are presented, and results from the two methods and the results of linear theory are compared The two sample motions, a sinking airfoil with steady forward velocity and an airfoil with increasing thickness, were chosen to provide a simple representation of the flutter-maneuver and rotor tip motions, respectively Results are presented for an NACA 0010 airfoil undergoing simultaneous angle of attack and free stream Mach number oscillations This computation is a strip theory simulation of the flowfield about an advancing helicopter rotor Author

N76-10037* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
CALCULATION OF INVISCID SHEAR FLOW USING A RELAXATION METHOD FOR THE EULER EQUATIONS
Joseph L Steger and Harvard Lomax *In its* Aerodynamic Analyses Requiring Advanced Computers, Pt 2 1975 p 811-838 refs

CSCL 20D
A fast block relaxation method was developed for the subsonic two-dimensional Euler equations The procedure is applied to the problem of computing inviscid flow about a thin airfoil in a moderately nonuniform stream (shear flow) It is demonstrated that the technique of overlapping grid regions can be used to improve the convergence rate of block relaxation methods Solutions and possible extensions are discussed Author

N76-10038* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
PROCESS IN APPLICATION OF DIRECT ELLIPTIC SOLVERS TO TRANSONIC FLOW COMPUTATIONS
Dale Martin *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 839-870 refs

CSCL 20D
Progress is described in the development and extension of a semi-direct iterative computational method for the rapid finite-difference solution of transonic flow over airfoils Additions and modifications to an earlier formulation are shown to produce stability (and therefore iterative convergence) of the iteration procedure based on use of an extended direct elliptic solver for strongly supercritical flows governed by mixed elliptic-hyperbolic equations An improved version of an extrapolation technique introduced earlier is also described Preliminary results computed by the semi-direct method for pressure distributions on a biconvex airfoil agree with solutions computed using the improved Murman-Cole line relaxation method The preliminary time per iteration for a 39x32 mesh on a CDC 7600 computer is 0 040 sec and a strong transonic case required 23 iterations or 0 92 sec These results indicate a significant potential for highly efficient transonic flow computations Author

N76-10039* National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
RECENT DEVELOPMENTS IN PROPULSIVE-LIFT AERODYNAMIC THEORY
Richard J Margason Long P Yip and Thomas G Gainer *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 871-895 refs
CSCL 01A
The progress is reviewed of propulsive-lift theories from their beginning in 1956 with Spence's development of a two-dimensional jet flap to the present general three-dimensional theories that require a large computer Results of jet-flap theories are compared for high-aspect-ratio wings with full- or partial-span blowing Applications of the jet-flap theory and the more general wing-jet interaction theories under development to externally blown flap and upper-surface blowing configurations are also discussed The possible direction of future developments is indicated Author

N76-10040* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
SURVEY OF COMPUTATIONAL METHODS FOR LIFT-GENERATED WAKES
Vernon J Rossow *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 897-923 refs

CSCL 01A
A survey is made of some computational methods that are used to predict the structure and duration of lift-generated vortices and to explore mechanisms that might significantly reduce their lifetime and hazard potential Author

N76-10042* Boeing Commercial Airplane Co Seattle Wash
ADVANCED PANEL-TYPE INFLUENCE COEFFICIENT METHODS APPLIED TO SUBSONIC AND SUPERSONIC FLOWS
F Edward Ehlers, Forrester T Johnson and Paul E Rubbert *In* NASA Langley Res Center Aerodynamic Analyses Requiring Advanced Computers, Pt 2 1975 p 939-984 refs

(Contract NAS2-7729)
CSCL 20D
Advanced techniques are presented for solving the linear integral equations of subsonic and supersonic potential flow in three dimensions Both analysis (Neumann) and design (Dirichlet) boundary conditions are treated Influence coefficient methods were used that encompass both source and doublet panels as boundary surfaces The methods employ curved panels possessing singularity strengths which vary as polynomials These and other features were selected to produce a stable, reliable accurate and economical scheme overcoming many problems experienced with earlier methods Computational results are presented that illustrate these advantages Author

N76-10043* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
SOME RECENT APPLICATIONS OF THE SUCTION ANALOGY TO VORTEX-LIFT ESTIMATES
John E Lamar *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 985-1011 refs

CSCL 01A
A recent extension of the suction analogy for the estimation of vortex lift along the side edge of wings is reviewed and the concept of an augmented vortex lift was developed to account for the effect of the leading-edge vortex passing downstream over an aft part of the model Applications of these extensions resulted in an improved estimating capability for a wide range of isolated sharp-edge planforms and also for multiple lifting surfaces The suction analogy concept has wider applicability at both subsonic and supersonic speeds especially in the preliminary design cycle Author

N76-10044* Boeing Co, Seattle, Wash
A THREE-DIMENSIONAL SOLUTION OF FLOWS OVER WINGS WITH LEADING EDGE VORTEX SEPARATION
James A Weber, Guenter W Brune, Forrester T Johnson Paul Lu, and Paul E Rubbert *In* NASA Langley Res Center Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 1013-1032 refs
(Contract NAS1-12185)
CSCL 20D
The application of a general, potential flow computational technique to the solution of the subsonic three-dimensional flow over wings with leading edge vortex separation is presented The method is capable of predicting forces moments, and detailed surface pressures on thin sharp-edged wings of rather arbitrary planform The wing geometry is arbitrary in the sense that leading and trailing edges may be curved or kinked and may have arbitrary camber and twist distributions The method employs an inviscid flow model in which the wing the rolled-up vortex sheets and the wake are represented by piecewise continuous quadratic doublet sheet distributions The Kutta condition is imposed and satisfied along all wing edges Strengths of the doublet distributions as well as shape and position of the vortex spirals are

computed in iterative fashion starting with an assumed initial sheet geometry The method is verified by numerous computed results and the extension to supersonic flow and more general configuration types is suggested Author

N76-10046* National Aeronautics and Space Administration Langley Research Center Langley Station Va
AN INTEGRATED SYSTEM FOR THE AERODYNAMIC DESIGN AND ANALYSIS OF SUPERSONIC AIRCRAFT
David S Miller and Wilbur D Middleton (Boeing Co) *In its* Aerodynamic Analyses Requiring Advanced Computers, Pt 2 1975 p 1049-1065 refs
CSCL 01C
An integrated system of computer programs is described The goals of the system were to develop an easily used supersonic design and analysis capability with recognition of the need for constraints on linear theory to provide physical realism and with inclusion of interactive graphics capability for increased control over the design and analysis iteration cycles Author

N76-10047* Boston Univ Mass
INDICIAL COMPRESSIBLE POTENTIAL AERODYNAMICS AROUND COMPLEX AIRCRAFT CONFIGURATIONS
Luigi Morino and Lee-Tzong Chen *In* NASA Langley Res Center Aerodynamics Analyses Requiring Advanced Computers Pt 2 1975 p 1067-1110 refs

(Grant NGR-22-004-030)
CSCL 01C
A general theory for indicial potential compressible aerodynamics around complex configurations is presented The motion is assumed to consist of constant subsonic or supersonic speed for time t less than or equal to 0 (steady state) and of small perturbations around the steady state for time t greater than 0 Using the finite-element method to discretize the space problem a set of differential-delay equations was obtained in time relating the potential to its normal derivative on the surface of the body The aerodynamic transfer function was obtained by using standard methods of operational calculus The theory is embedded in a computer code SUSSA ACTS, which is briefly described Numerical results are presented for steady and unsteady subsonic and supersonic flows and indicate that the code is not only general flexible and simple to use but also accurate and fast Author

N76-10049* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
COMPARISONS OF THEORETICAL AND EXPERIMENTAL PRESSURE DISTRIBUTIONS ON AN ARROW-WING CONFIGURATION AT TRANSONIC SPEED
Marjorie E Manro (Boeing Commercial Airplane Co) Edward N Tinoco (Boeing Commercial Airplane Co), Percy J Bobbitt and John T Rogers (Boeing Commercial Airplane Co) *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 1141-1188 refs Sponsored in part by the Boeing Co
(Contract NAS1-12875)
CSCL 01A
A wind-tunnel test of an arrow-wing-body configuration employing both a twisted and a flat wing, as well as a variety of leading- and trailing-edge flap deflections was conducted to provide an experimental data base for comparison with theoretical methods The purpose of these comparisons was to delineate conditions under which the theoretical predictions are valid for aeroelastic calculations and to explore the use of empirical methods to correct the theoretical methods where theory is deficient Test-theory comparisons of detailed pressure distributions were made using current state-of-the-art linear and separated flow computer programs The results of attempting to make empirical corrections to the theoretical methods and of using two-dimensional separation criteria to predict flow separation are shown Author

N76-10050* National Aeronautics and Space Administration Langley Research Center Langley Station, Va
NUMERICAL MODELING OF TUNNEL-WALL AND BODY SHAPE EFFECTS ON TRANSONIC FLOW OVER FINITE LIFTING WINGS
Perry A Newman and E B Klunker *In its* Aerodynamics Analyses Requiring Advanced Computers Pt 2 1975 p 1189-1212 refs
CSCL 20D
Preliminary computational results were obtained for two problems relating to interference effects in transonic flow over finite lifting wings The first is concerned with the numerical modeling of the flow about a three-dimensional wing configuration within a wind tunnel and the second is concerned with calculating favorable interference effects produced by the body of a wing-body configuration For both problems the calculations were based upon a small disturbance potential equation which is solved using a relaxation technique A number of tunnel-wall boundary conditions are simulated and a comparison is made with experimental data Author

N76-10052* National Aeronautics and Space Administration Langley Research Center Langley Station Va
AXISYMMETRIC TRANSONIC FLOW INCLUDING WIND TUNNEL WALL EFFECTS
Jerry C South Jr and James D Keller *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 1233-1367 refs
CSCL 20D
A method is presented for obtaining numerical solutions to the problem of transonic flow past axisymmetric bodies in a wind tunnel Parabolic coordinates are sheared and stretched so that the flow region between the body and the tunnel wall is mapped onto a rectangular computational plane A finite-difference analog of the exact compressible potential equation is solved with a column iteration scheme which uses Jameson s rotated retarded differences in supersonic regions and central differences in subsonic regions The flow tangency condition at the surface is enforced by a dummy-point method and the wind-tunnel wall boundary condition is satisfied by a one-sided difference method Solutions were obtained for a supercritical body of revolution and compared with previous calculations by RAXBOD a program developed by South and Jameson for bodies in free air and with experiments The present results are not as accurate as the RAXBOD results for the same number of mesh points and convergence is slow on the fine mesh The method works well for two-dimensional symmetric airfoils Author

N76-10054* National Aeronautics and Space Administration Langley Research Center Langley Station Va
APPROXIMATE METHOD FOR CALCULATING TRANSONIC FLOW ABOUT LIFTING WING BODY COMBINATIONS
Richard W Barnwell *In its* Aerodynamic Analyses Requiring Advanced Computers Pt 2 1975 p 1281-1303 refs

CSCL 01A
A fast approximate method is described for calculating transonic flow about lifting configurations with swept leading edges and aspect ratios of order 1 at angles of attack of the order of the equivalent-body thickness-length ratio The method accounts for shock waves leading-edge separation and wind-tunnel wall effects and is applicable throughout the Mach number range from zero to low supersonic Author

N76-10062*# Aerophysics Research Corp, Bellevue Wash
APPLICATION OF MULTIVARIABLE SEARCH TECHNIQUES TO THE OPTIMIZATION OF AIRFOILS IN A LOW SPEED NONLINEAR INVISCID FLOW FIELD
Donald S Hague and Antony W Merz Jul 1975 74 p refs
(Contract NAS2-8599)
(NASA-CR-137760, TN-206) Avail NTIS HC $4 25 CSCL 01A
Multivariable search techniques are applied to a particular

class of airfoil optimization problems These are the maximization of lift and the minimization of disturbance pressure magnitude in an inviscid nonlinear flow field A variety of multivariable search techniques contained in an existing nonlinear optimization code, AESOP are applied to this design problem These techniques include elementary single parameter perturbation methods organized search such as steepest-descent quadratic and Davidon methods randomized procedures and a generalized search acceleration technique Airfoil design variables are seven in number and define perturbations to the profile of an existing NACA airfoil The relative efficiency of the techniques are compared It is shown that elementary one parameter at a time and random techniques compare favorably with organized searches in the class of problems considered It is also shown that significant reductions in disturbance pressure magnitude can be made while retaining reasonable lift coefficient values at low free stream Mach numbers Author

N76-10063*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
AERODYNAMIC CHARACTERISTICS OF A LARGE-SCALE HYBRID UPPER SURFACE BLOWN FLAP MODEL HAVING FOUR ENGINES
Robert J Carros, Alfred G Boissevain and Kiyoshi Aoyagi Jul 1975 82 p refs
(NASA-TM-X-62460 A-6202) Avail NTIS HC $4 75 CSCL 01A

Data are presented from an investigation of the aerodynamic characteristics of large-scale wind tunnel aircraft model that utilized a hybrid-upper surface blown flap to augment lift The hybrid concept of this investigation used a portion of the turbofan exhaust air for blowing over the trailing edge flap to provide boundary layer control The model tested in the Ames 40- by 80-foot Wind Tunnel had a 27 5 deg swept wing of aspect ratio 8 and 4 turbofan engines mounted on the upper surface of the wing The lift of the model was augmented by turbofan exhaust impingement on the wind upper-surface and flap system Results were obtained for three flap deflections for some variation of engine nozzle configuration and for jet thrust coefficients from 0 to 3 0 Six-component longitudinal and lateral data are presented with four engine operation and with the critical engine out In addition, a limited number of cross-plots of the data are presented All of the tests were made with a downwash rake installed instead of a horizontal tail Some of these downwash data are also presented Author

N76-10064*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
PRESSURE DATA FROM A 64A010 AIRFOIL AT TRANSONIC SPEEDS IN HEAVY GAS MEDIA OF RATIO OF SPECIFIC HEATS FROM 1 67 TO 1 12
Anthony R Gross and Frank W Steinle Jr Aug 1975 290 p refs
(NASA-TM-X-62468 A-6225) Avail NTIS HC $8 75 CSCL 01A

A NACA 64A010 pressure-instrumented airfoil was tested at transonic speeds over a range of angle of attack from -1 to 12 degrees at various Reynolds numbers ranging from 2 to 6 million in air argon Freon 12 and a mixture of argon and Freon 12 having a ratio of specific heats corresponding to air Good agreement of results is obtained for conditions where compressibility is not significant and for the air and comparable argon-Freon 12 mixture Comparison of heavy gas results with air when adjusted for transonic similarity show improved but less than desired agreement Author

N76-10066*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
AERODYNAMIC CHARACTERISTICS OF A TANDEM WING CONFIGURATION OF A MACH NUMBER OF 0 30
William P Henderson and Jarrett K Huffman Oct 1975 30 p refs
(NASA-TM-X-72778) Avail NTIS HC $3 75 CSCL 01A

An investigation was conducted to determine the aerodynamic characteristics of a tandem wing configuration The configuration had a low forward mounted sweptback wing and a high rear mounted sweptforward wing jointed at the wing tip by an end plate The investigation was conducted at a Mach number of 0 30 at angles of attack up to 20 deg A comparison of the experimentally determined drag due to lift characteristics with theoretical estimates is also included Author

N76-10067*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FLUCTUATING SURFACE PRESSURE MEASUREMENTS ON USB WING USING TWO TYPES OF TRANSDUCERS
James B Reed (Boeing Commercial Airplane Co Seattle) Oct 1975 31 p refs
(NASA-TM-X-72750) Avail NTIS HC $3 75 CSCL 01A

Measurements of the fluctuating pressures on the wing surface of an upper-surface-blown powered-lift model and a JT15 engine were obtained using two types of pressure transducers The pressures were measured using overall-fluctuating pressures and power spectral density analyses for various thrust settings and two jet impingement angles Comparison of the data from the two transducers indicate that similar results are obtained in the lower frequency ranges for both transducers The data also indicate that for this configuration the highest pressure levels occur at frequencies below 2000 Hz Author

N76-10068# European Space Agency Paris (France)
CALCULATION OF THE PRESSURE DISTRIBUTION INDUCED BY A JET ON A FLAT PLATE
Bao Tzang Yeh May 1975 45 p refs Transl into ENGLISH of Berechnung des strahlinduzierten Druckfeldes an einer ebenen Platte Rheinisch-Westfael Tech Hochschule Aachen Report DLR-FB-73-02 30 Aug 1973 Original German report available from DFVLR Porz West Ger 16 50 DM
(ESA-TT-159 DLR-FB-73-02) Avail NTIS HC $3 75

The pressure distribution induced by a jet on a flat plate was examined based on the potential flow theory For free jets the calculation is successfully achieved as a distribution of sinks along the jet s centerline The effects of a crosswind (jet blockage and jet wake) were simulated as doublet and two counter-rotating line vortices Two models for obtaining the jet-induced flow field are presented a sink-doublet-vo model, and a sink-doublet-vortex model Comparisons with test data indicate that the second model is more successful than the first Author (ESA)

N76-10069# European Space Agency Paris (France)
SOME PROBLEMS IN RESEARCH ON WHIRL FLUTTER IN V/STOL AIRCRAFT
F Kiessling May 1975 103 p refs Transl into ENGLISH of "Zur Problematik der Whirl-Flatteruntersuch von V/STOL-Flugzeugen' DFVLR Goettingen West Ger Report DLR-FB-74-11, 15 Feb 1974 Original German report available from DFVLR Porz, West Ger 32 40 DM
(ESA-TT-160, DLR-FB-74-11) Avail NTIS HC $5 25

The present state-of-art concerning propeller-rotor whirl flutter of V/STOL aircraft is reviewed The basic physical relations of this flutter phenomenon are explained and the various elastomechanic models and the aerodynamic theories used are described The related equations of motion are presented where special emphasis is given to the analytical treatment of the aeroelastic stability problem Some available analytical results are critically compared with those obtained from experimental investigations Some open questions to the whirl flutter problem are discussed and possibilities for a further improvement of whirl flutter investigations are presented Author (ESA)

N76-10071# European Space Agency Paris (France)
ANALYSIS OF THE FLOW FIELD OF CROSS BLOWN LIFTING JETS BY FLOW FIELD MEASUREMENTS
Hans-Juergen Graefe Jun 1975 72 p refs Transl into ENGLISH of ' Anal des Stroemungsfeldes von querangeblasenen Freistrahlen nach Stroemungsfeldmessungen" Porz, West Ger Report DLR-FB-75-14 1975 Original German report available from DFVLR Porz, West Ger 28 DM
(ESA-TT-165 DLR-FB-75-14) Avail NTIS HC $4 25

The directional field of cross blown jets was measured point by point with a directional probe The investigations were

performed with a cold compressed air jet which emerged perpendicularly from a cylindrical fuselage The results are given by isocline and also by streamline plots the latter being obtained by integration of the directional field The dependence of the flow field on the dynamic pressure ratio is analyzed The correlation of local flow direction within the plane of symmetry with the local inclination of the jet centerline is treated in detail
Author (ESA)

N76-10078# Naval Postgraduate School, Monterey Calif
FLOW VISUALIZATION STUDIES OF THE XFV-12A M S Thesis
Charles Lewis Peterson Mar 1975 92 p refs
(AD-A010794) Avail NTIS CSCL 01/3

The XFV-12A incorporates thrust augmentation to generate propulsive lift Under the influence of forward flight the lift jets are subject to bending, which produces shed vortices that induce velocities at the aircraft Additionally operations in ground effect during hover and for small forward velocities can result in reingestion of engine exhaust gases The objectives of this thesis were twofold The first was to investigate analytically aspects of the vortex shedding phenomenon through the application of potential flow around the lifting surfaces of the aircraft Secondly experimental analysis was performed to determine the unique reingestion properties of the XFV-12A operating statically under various wing and canard configurations GRA

N76-10080# Army Aviation Systems Command St Louis Mo
MAJOR ITEM SPECIAL STUDY (MISS), UH-1 TAIL ROTOR BLADE Interim Report, Jan 1964 - Jun 1974
May 1975 22 p
(AD-A010652 USAAVSCOM-TR-75-17) Avail NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA Form 2410 reportable components These are time change items and certain condition change items selected because of high cost or need for intensive management Basically the MISS reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency (MIRF) report The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting From this data, removal distribution can be plotted and an MTR (Mean Time to Removal) can be calculated The MISS reports then investigate possible cost savings based on total elimination of selected failure modes These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program (PIP) areas GRA

N76-10082# Ultrasystems, Inc Phoenix Ariz Dynamic Science Div
HELICOPTER TROOP/PASSENGER RESTRAINT SYSTEMS DESIGN CRITERIA EVALUATION Final Report, 1 Jun 1973 - 1 Apr 1975
Richard W Carr Jun 1975 155 p
(Contracts DAAJ02-73-C-0077 DAAJ02-74-C-0034 DA Proj 1F2-62205-AH-88)
(AD-A012270 USAAMRDL-TR-75-10) Avail NTIS CSCL 01/3

A systems analysis of a new restraint systems for troop restraint systems in helicopters was conducted Hardware was designed and statically tested in accordance with the requirements of two proposed specifications Design iterations were required on some hardware components and three designs to be dynamically tested were developed Dynamic testing of the restraint systems revealed additional weaknesses design modifications were incorporated and testing was reconducted until satisfactory results were obtained The proposed specifications were modified and refined in accordance with the test results with the net effect that the two specifications as they now stand define advanced restraint systems providing optimum restraint for occupants of Army aircraft which can be built within existing state of the art are low in weight and have reasonable cost GRA

N76-10088*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
HIGH PERFORMANCE DASH ON WARNING AIR MOBILE, MISSILE SYSTEM
Alan D Levin Charles R Castellano and Don S Hague (Aerophysics Res Corp Bellevue Wash) Sep 1975 127 p refs
(NASA-TM-X-62479 A-6260) *Avail* NTIS HC $5 75 CSCL 01A

An aircraft-missile system which performs a high acceleration takeoff followed by a supersonic dash to a safe distance from the launch site is presented Topics considered are (1) technological feasibility to the dash on warning concept (2) aircraft and boost trajectory requirements and (3) partial cost estimates for a fleet of aircraft which provide 200 missiles on airborne alert Various aircraft boost propulsion systems were studied such as an unstaged cryogenic rocket an unstaged storable liquid and a solid rocket staged system Various wing planforms were also studied Vehicle gross weights are given The results indicate that the dash on warning concept will meet expected performance criteria and can be implemented using existing technology, such as all-aluminum aircraft and existing high-bypass-ratio turbofan engines Author

N76-10089*# Aerophysics Research Corp Bellevue, Wash
MULTIVARIATE ANALYSIS, RETRIEVAL, AND STORAGE SYSTEM (MARS) VOLUME 1 MARS SYSTEM AND ANALYSIS TECHNIQUES
D S Hague J D Vanderberg and N W Woodbury May 1974 68 p refs
(Contract NAS2-7627)
(NASA-CR-137671) Avail NTIS HC $4 25 CSCL 01C

A method for rapidly examining the probable applicability of weight estimating formulae to a specific aerospace vehicle design is presented The Multivariate Analysis Retrieval and Storage System (MARS) is comprised of three computer programs which *sequentially operate on the weight and geometry characteristics* of past aerospace vehicles designs Weight and geometric characteristics are stored in a set of data bases which are fully computerized Additional data bases are readily added to the MARS system and/or the existing data bases may be easily expanded to include additional vehicles or vehicle characteristics Author

N76-10090*# Aerophysics Research Corp Bellevue Wash
MULTIVARIATE ANALYSIS, RETRIEVAL, AND STORAGE SYSTEM (MARS) VOLUME 4 TURBOJET AND TURBOFAN DATA BASE (BY ENGINE)
D S Hague J D Vanderburg and N W Woodbury May 1975 32 p
(Contract NAS2-7627)
(NASA-CR-137674) Avail NTIS HC $3 75 CSCL 01C

A partial listing of turbojet and turbofan engine specifications data as provided by the MARS (Multivariable Data Analysis Retrieval and Storage) system was given for a number of engines Author

N76-10091*# Aerophysics Research Corp Bellevue Wash
MULTIVARIATE ANALYSIS, RETRIEVAL, AND STORAGE SYSTEM (MARS) VOLUME 6 MARS SYSTEM, A SAMPLE PROBLEM (GROSS WEIGHT OF SUBSONIC TRANSPORTS)
D S Hague and N W Woodbury Jul 1975 31 p refs
(Contract NAS2-7627)
(NASA-CR 137722) *Avail* NTIS HC $3 75 CSCL 01C

The MARS system is a tool for rapid prediction of aircraft or engine characteristics based on correlation-regression analysis of past designs stored in the data bases An example of output obtained from the MARS system which involves derivation of an expression for gross weight of subsonic transport aircraft in terms of nine independent variables is given The need is illustrated for careful selection of correlation variables and for continual review of the resulting estimation equations
Author

N76-10092*# Texas A&M Univ College Station Dept of Electrical Engineering
THE DESIGN, ANALYSIS AND EXPERIMENTAL EVALUATION OF AN ELASTIC MODEL WING
Ralph K Cavin, III and Chavalit Thisayakorn Sep 1974 51 p refs
(Contract NAS9-11303)
(NASA-CR-144535) Avail NTIS HC $4 25 CSCL 01C

An elastic orbiter model was developed to evaluate the effectiveness of aeroelasticity computer programs The elasticity properties were introduced by constructing beam-like straight wings for the wind tunnel model A standard influence coefficient mathematical model was used to estimate aeroelastic effects analytically In general good agreement was obtained between the empirical and analytical estimates of the deformed shape However, in the static aeroelasticity case, it was found that the physical wing exhibited less bending and more twist than was predicted by theory Author

N76-10093*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
COMPARISON OF MODEL AND FLIGHT TEST DATA FOR AN AUGMENTED JET FLAP STOL RESEARCH AIRCRAFT
W L Cook and D C Whittley Jun 1975 45 p refs
(NASA-TM-X-62491 A-6303) Avail NTIS HC $3 75 CSCL 01C

Aerodynamic design data for the Augmented Jet Flap STOL Research Aircraft or commonly known as the Augmentor-Wing Jet-STOL Research Aircraft was based on results of tests carried out on a large scale research model in the NASA Ames 40- by 80-Foot Wind Tunnel Since the model differs in some respects from the aircraft precise correlation between tunnel and flight test is not expected however the major areas of confidence derived from the wind tunnel tests are delineated and for the most part tunnel results compare favorably with flight experience In some areas the model tests were known to be nonrepresentative so that a degree of uncertainty remained these areas of greater uncertainty are identified and discussed in the light of subsequent flight tests Author

N76-10094*# Lockheed California Co Burbank
STUDY OF FLUTTER RELATED COMPUTATIONAL PROCEDURES FOR MINIMUM WEIGHT STRUCTURAL SIZING OF ADVANCED AIRCRAFT, SUPPLEMENTAL DATA
R F OConnell H J Hassig and N A Radovich Aug 1975 41 p refs
(Contract NAS1-12121)
(NASA-CR-132722) Avail NTIS HC $3 75 CSCL 01C

Computational aspects of (1) flutter optimization (minimization of structural mass subject to specified flutter requirements) (2) methods for solving the flutter equation and (3) efficient methods for computing generalized aerodynamic force coefficients in the repetitive analysis environment of computer-aided structural design are discussed Specific areas included a two-dimensional Regula Falsi approach to solving the generalized flutter equation, method of incremented flutter analysis and its applications the use of velocity potential influence coefficients in a five-matrix product formulation of the generalized aerodynamic force coefficients, options for computational operations required to generate generalized aerodynamic force coefficients theoretical considerations related to optimization with one or more flutter constraints, and expressions for derivatives of flutter-related quantities with respect to design variables Author

N76-10095*# National Aeronautics and Space Administration Washington D C
FLIGHT FLUTTER TESTING SYMPOSIUM
1975 196 p refs Symp held at Washington D C, 15-16 May 1958 sponsored by Aircraft Ind Assoc and AFOSR
(NASA-SP-385) Avail NTIS HC $7 00 CSCL 01C

Papers presented at the conference are reported Subjects discussed include theory methods and techniques and flight flutter testing

N76-10096* California Inst of Tech Pasadena
A THEORY OF FLIGHT FLUTTER TESTING
Erik Molloe-Christensen *In* NASA Washington Flight Flutter Testing Symp 1975 p 3-6 refs

CSCL 01C

Flight flutter testing is considered as a method for finding generalized aerodynamic forces The coefficients determined from flight flutter tests are used in flutter calculations using a simple expansion in frequency and Mach number The errors in the procedure are discussed and expressions for the error in flutter prediction are given Methods of testing procedure are discussed Author

N76-10097* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
A GENERAL AERODYNAMIC APPROACH TO THE PROBLEM OF DECAYING OR GROWING VIBRATIONS OF THIN, FLEXIBLE WINGS WITH SUPERSONIC LEADING AND TRAILING EDGES AND NO SIDE EDGES
R W Warner *In its* Flight Flutter Testing Symp 1975 p 7-12 refs
CSCL 01C

Indicial aerodynamic influence coefficients were evaluated from potential theory for a thin flexible wing with supersonic leading and trailing edges only The analysis is based on the use of small surface areas in which the downwash is assumed uniform Within this limitation the results are exact except for the restriction of linearized theory The areas are not restricted either to square boxes or Mach boxes A given area may be any rectangle or square which may or may not be cut by the Mach forecone, and any area can be used anywhere in the forecone without loss of accuracy Author

N76-10098* Lockheed Aircraft Corp Burbank Calif
IN-FLIGHT DAMPING MEASUREMENT
G E Sanderson and E A Bartsch *In* NASA Washington Flight Flutter Testing Symp 1975 p 13-21 refs

CSCL 01C

A new testing technique is described which can be applied in determining the damping coefficient of the critical vibration modes of an airplane in flight The damping coefficient can be determined in several different ways from the same data using different features of a modified response curve which implies the possibility of checking one value against the other The method introduces the effect of sweep rate in the driving system This effect on the frequency response curve of the critical vibration mode and its various characteristics are used in the determination of damping coefficient A theoretical examination is made of these characteristics for single degree of freedom systems Author

N76-10101* National Aeronautics and Space Administration Langley Research Center Langley Station, Va
A FLIGHT INVESTIGATION OF OSCILLATING AIR FORCES EQUIPMENT AND TECHNIQUE
W H Reed III *In its* Flight Flutter Testing Symp 1975 p 41-50 refs
CSCL 01C

The equipment and techniques are described which are to be used in a project aimed at measuring oscillating air forces and dynamic aeroelastic response of a swept wing airplane at high subsonic speeds Electro-hydraulic inertia type shakers installed in the wing tips will excite various elastic airplane modes while the related oscillating chordwise pressures at two spanwise wing stations and the wing mode shapes are recorded on magnetic tape The data reduction technique following the principle of a wattmeter harmonic analyzer employed by Bratt Wight and Tilly utilizes magnetic tape and high speed electronic multipliers to record directly the real and imaginary components of oscillatory data signals relative to a simple harmonic reference signal Through an extension of this technique an automatic flight-flutter-test data analyzer is suggested in which vector plots of mechanical admittance or impedance would be plotted during the flight test Author

N76-10104* Douglas Aircraft Co Inc El Segundo Calif
FLIGHT FLUTTER TESTING USING PULSE TECHNIQUES
R H Stringham, Jr and E J Lenk *In* NASA, Washington Flight Flutter Testing Symp 1975 p 69-72

CSCL 01C

A case of flutter developed at a speed lower than had been flown previously This incident precipitated the routine procedure of pulsing control surfaces as well as the firing of explosive charges during speed build-ups In the interest of rapid evaluation of results simple methods of data reduction were used A case history is presented where in the pulse technique predicted flutter by extrapolating decay rates obtained at subcritical speeds, in addition a case is presented where no valid extrapolation could be made Author

N76-10105* Grumman Aircraft Engineering Corp Bethpage N Y
STABILIZER FLUTTER INVESTIGATED BY FLIGHT TEST
E F Baird N S Sinder and R B Wittman *In* NASA Washington Flight Flutter Testing Symp 1975 p 73-81

CSCL 01C

Flight flutter tests were conducted on an experimental airplane which resulted in the successful prediction of a limited amplitude stabilizer flutter at supersonic speeds The flutter obtained was unusual in that fore and aft bending of the stabilizer carry-through structure contributed to the flutter condition During flight tests the impending flutter condition was observed from force per unit amplitude damping coefficient and frequency measurements A description is given of the physical and operational characteristics of the test equipment and telemetering facilities A flutter analysis using measured modes and incompressible two-dimensional strip air forces yielded a conservative flutter speed Sled tests of a similar stabilizer configuration had lead to the conclusion that flutter would not be encountered Certain overall conclusions are reached regarding this particular flight flutter testing program and the need for a concerted research effort in this field Author

N76-10107* Martin Co Baltimore Md
FLIGHT FLUTTER TESTING OF THE P6M
G Kachadourian R L Goldman and D M Roha *In* NASA Washington Flight Flutter Testing Symp 1975 p 91-96 refs

CSCL 01C

On the P6M the shake behavior, i e the response to random excitation at subcritical speeds of lowly damped airplane modes is as important as the actual flutter speed The approach is to first study the problem by means of analyses and wind-tunnel tests These predictions are compared with flight test data obtained by spectral analysis of tape recordings of the airplane vibration responses to random aerodynamic turbulence A similar spectrum analysis approach was used in high speed wind-tunnel tests A resonance excitation technique was developed for low speed wind-tunnel testing and well defined V-g curves were obtained The effect of various parameters on both shake and flutter of T-tails with and without dihedral were studied Preliminary flight tests yielded good correlation they also yielded interesting information concerning a low frequency transonic snaking mode and excitation by shed vortices Author

N76-10108* McDonnell Aircraft Co St Louis Mo
TRANSIENT FLIGHT FLUTTER TEST OF A WING WITH TIP TANKS
R J Werdes *In* NASA Washington Flight Flutter Testing Symp 1975 p 97-102
CSCL 01C

Wing flutter was encountered during flight testing of the F2H-2 airplane with full wing tip tanks As a result more refined theoretical analysis as well as flight flutter tests were initated to establish corrective measures and to experimentally verify the stability of the improved system The results from the flight flutter tests, utilizing the transient response technique are presented The method of excitation consisted of abrupt deflections of the ailerons resulting from stick bangs and data were measured by wing tip accelerometers A comparison of the results with theoretical predictions is presented and indicates that reasonably good correlation was obtained The influence on wing flutter of tip tank fuel transfer cycle which was incorporated to control the center of gravity range of the tank during defueling is indicated by the measured results and compared with the theory The final configuration utilized a transfer cycle which was proven stable as a result of flight flutter testing It is concluded that transient response measurements resulting from stick bangs provide a reasonably reliable and safe technique of flight flutter testing for wings with external tanks or heavy stores Author

N76-10109* Boeing Commercial Airplane Co Seattle Wash
FLIGHT FLUTTER TESTING OF MULTI-JET AIRCRAFT
J Bartley *In* NASA Washington Flight Flutter Testing Symp 1975 p 103-110
CSCL 01C

Extensive flight flutter tests were conducted by BAC on B-52 and KC-135 prototype airplanes The need for and importance of these flight flutter programs to Boeing airplane design are discussed Basic concepts of flight flutter testing of multi-jet aircraft and analysis of the test data will be presented Exciter equipment and instrumentation employed in these tests will be discussed Author

N76-10110* General Dynamics/Convair San Diego Calif
FLIGHT FLUTTER TESTING OF SUPERSONIC INTERCEPTORS
M Dublin and R Peller *In* NASA Washington Flight Flutter Testing Symp 1975 p 111-120 refs

CSCL 01C

A summary is presented of experiences in connection with flight flutter testing of supersonic interceptors The planning and operational aspects involved are described along with the difficulties encountered and the correlation between measurement and theory Recommendations for future research and development to advance the science of flight flutter testing are included Author

N76-10111* General Dynamics/Fort Worth Tex
FLIGHT FLUTTER TESTING THE B-58 AIRPLANE
P T Mahaffey *In* NASA Washington Flight Flutter Testing Symp 1975 p 121-125
CSCL 01C

The flight flutter tests on the B-58 airplane are described, and the philosophy of flight flutter testing is discussed The instrumentation used in the airplane and in the telemetering receiving station on the ground is described along with the methods used for exciting the airplane and the flight test procedure Also described is the type of data obtained and its reduction An evaluation of the procedure and instrumentation is given with a discussion of desirable improvements for future testing Author

N76-10112* Douglas Aircraft Co Inc Santa Monica Calif
DOUGLAS EXPERIENCE IN FLIGHT FLUTTER TESTING
J Philbrick *In* NASA Washington Flight Flutter Testing Symp 1975 p 127-132
CSCL 01C

Douglas Aircraft Company experience in flight flutter testing is reviewed briefly with comments on state-of-the-art excitation and instrumentation techniques used up to the present time The limitations of previous techniques are discussed with emphasis on the problem of (1) establishing a flutter margin of safety for predicted marginal flutter modes (2) resolving instances of flutter not predicted by theoretical calculations in advance and (3) delaying the airplane demonstration by time consumed in acquisition and reduction of flutter data Current Douglas philosophy in flight flutter testing is presented and a description given of steady-state vane excitation system development automatic data handling system and the potential application of automatic computing methods for increasing flutter data yield Author

N76-10114* McDonnell Aircraft Co St Louis Mo
TRANSONIC FLIGHT FLUTTER TESTS OF A CONTROL SURFACE UTILIZING AN IMPEDANCE RESPONSE TECHNIQUE
L I Mirowitz *In* NASA Washington Flight Flutter Testing Symp 1975 p 143-153 refs

CSCL 01C
Transonic flight flutter tests of the XF3H-1 Demon Airplane were conducted utilizing a frequency response technique in which the oscillating rudder provides the means of system excitation These tests were conducted as a result of a rudder flutter incident in the transonic speed range The technique employed is presented including a brief theoretical development of basic concepts Test data obtained during the flight are included and the method of interpretation of these data is indicated This method is based on an impedance matching technique It is shown that an artificial stabilizing device such as a damper may be incorporated in the system for test purposes without complicating the interpretation of the test results of the normal configuration Data are presented which define the margin of stability introduced to the originally unstable rudder by design changes which involve higher control system stiffness and external damper It is concluded that this technique of flight flutter testing is a feasible means of obtaining flutter stability information in flight Author

N76-10116*# Lockheed-California Co Burbank
FLIGHT SERVICE EVALUATION OF KEVLAR-49/EPOXY COMPOSITE PANELS IN WIDE-BODIED COMMERCIAL TRANSPORT AIRCRAFT Annual Report
R H Stone Oct 1975 30 p refs
(Contract NAS1-11621)
(NASA-CR 132733 AR-2) Avail NTIS HC $3 75 CSCL 01C
Kevlar-49 fairing panels were inspected and found to be performing satisfactorily after two years flight service on an Eastern and an Air Canada L-1011 Six panels are on each aircraft including sandwich and solid laminate wing-body panels and 300 F service aft engine fairings Some of the panels were removed from the aircraft to permit inspection of inner surfaces and fastener hole conditions Minor defects such as surface cracks due to impact damage small delaminated areas elongation and fraying of fastener holes were noted None of these defects were considered serious enough to warrant corrective action in the opinion of airline personnel The defects are typical for the most part of defects noted on similar fiberglass parts Author

N76-10117# European Space Agency, Paris (France)
STATIC LOAD TESTS ON AN LFU 205 WING OF SPANWISE TUBULAR CONSTRUCTION
Rainer Schuetze May 1975 44 p refs Transl into ENGLISH of Statische Belastungsvers an einer Tragflaeche der LFU-205 in Laengsschlauchbauweise DFVLR Brunswick Report DLR-Mitt-74-02 1974 Original German report available from DFVLR Porz West Ger 12 DM
(ESA-TT-162 DLR-Mitt-74-02) Avail NTIS HC $3 75
Tests were performed on a wing of the lightweight aircraft LFU 205 The wing was tested in critical load cases up to 1 5 times the value of the safe load Even higher safe load values were to some extent achieved The test results provide information on the tensile strength stability and deformation characteristics of the wing and thus permit an assessment of the spanwise tubular method of construction Author (ESA)

N76-10118# Rockwell International Corp Los Angeles Calif Aircraft Div
DOCUMENTATION OF SURVIVABILITY/VULNERABILITY RELATED AIRCRAFT MILITARY SPECIFICATIONS AND STANDARDS Final Report, Sep 1973 - Jun 1974
W D Dotseth and R W Nickel Apr 1975 176 p refs
(Contract F33615-73-C-3147 AF Proj 6065)
(AD-A011509 JTCG/AS-74-D-003) Avail NTIS CSCL 01/3
The purpose was to identify military specifications and standards which impact S/V (survivability and vulnerability) of combat aircraft and document the nonnuclear (including high energy lasers) S/V provisions and requirements noting the deficiencies in these documents This report contains the results of this study with specifications and standards listed in alphanumeric order including identification of S/V provisions and/or deficiencies GRA

N76-10119# Army Aviation Systems Command St Louis Mo
ROTAR INDUCED POWER Final Report
Milton A Schwartzberg May 1975 37 p refs
(DA Proj 1F2-62209-AH-76)
(AD-A011270 USAAVSCOM-TR-75-10) Avail NTIS CSCL 01/1
Methodology is presented for rapid estimation of the induced power requirements of a helicopter rotor Operating ranges treated are hover in or out of ground effect vertical climb, and level flight Earlier work on this subject is modified by more recent flight test information on ground effect enlarged in scope by the consideration of a generalized trapezoidal inflow velocity scope by the consideration of a generalized trapezoidal inflow velocity distribution at the rotor and refined to account for the influence of level flight on the effect of a non-uniform induced velocity distribution at the rotor GRA

N76-10120# Air Force Materials Lab Wright-Patterson AFB Ohio
JOINT AIRCRAFT LOADING/STRUCTURE RESPONSE STATISTICS OF TIME TO SERVICE CRACK INITIATION Technical Report, Jan - Jun 1974
Jann-Nan Yang and Walter J Trapp Nov 1974 48 p refs
(AF Proj 7351)
(AD-A011646 AFML-TR-74-174) Avail NTIS CSCL 01/3
A reliability analysis for predicting the statistical distribution of time to fatigue crack initiation for aircraft structures in service is presented The present analysis uses the statistical data of the specimen fatigue tests the full-scale structure tests and the statistical dispersion of aircraft service loads The statistical distribution of the fatigue performance of the full-scale structure under laboratory loading spectrum is assumed to be Weibull The service loads for gust turbulences are modeled as Poisson processes for transport-type aircraft while the maneuver loads are modeled as compound Poisson processes for fighter and training aircrafts GRA

N76-10121# Army Aviation Systems Command St Louis, Mo
UH-1H ASSESSMENT AND COMPARATIVE FLEET EVALUATIONS Final Excutive Summary Report
Apr 1975 175 p
(AD-A010784 USAAVSCOM-TR-75-3) Avail NTIS CSCL 01/3
The purpose of the executive summary is to provide an overview and summarization of the UH-1H assessment The parameters presented provide management perspective of the UH-1H fleet in addition to comparative fleet evaluations Various presentations of RAM related parameters give the present system posture of the UH-1H fleet GRA

N76-10122# LTV Aerospace Corp Dallas Tex Vought Systems Div
AAES FAILURE MODES AND REQUIREMENTS FOR AIMIS INTERFACE Final Report, 22 Jan - 1 Nov 1974
H W Heinzman and J R Perkins Dec 1974 182 p refs
(Contract N62269-74-C-0265)
(AD-A010550 Rept-2-57110/4R-3187) Avail NTIS CSCL 01/3
The study was conducted to lay the initial groundwork for a smooth and timely interface between the AIMIS (Advanced Integrated Modular Instrumentation System) and the AAES (Advanced Aircraft Electrical System) Primary failure modes of the SOSTEL (Solid State Electric Logic) system are identified Level of criticality is indicated for each failure mode and priorities

for display of malfunction information are established Multimode switch approaches and interface memory requirements are discussed Techniques are established for converting failure data into messages the pilot can immediately understand A word code technique is recommended as a means for simplifying the SOSTEL/AIMIS interface and minimizing interface memory requirements The A-7B power distribution and armament station control unit (ASCU) subsystems are used as the data base for the study GRA

N76-10123*# Georgia Inst of Tech Atlanta
COMBUSTION GENERATED NOISE IN GAS TURBINE COMBUSTORS
W C Strahle and B N Shivashankara Aug 1974 41 p refs
(Contract NAS3-17861)
(NASA-CR-134843) Avail NTIS HC $3 75 CSCL 21E

Experiments were conducted to determine the noise power and spectra emitted from a gas turbine combustor can exhausting to the atmosphere Limited hot wire measurements were made of the cold flow turbulence level and spectra within the can The fuels used were JP-4 acetone and methyl alcohol burning with air at atmospheric pressure The experimental results show that for a fixed fuel the noise output is dominated by the airflow rate and not the fuel/air ratio The spectra are dominated by the spectra of the cold flow turbulence spectra which were invariant with airflow rate in the experiments The effect of fuel type on the noise power output was primarily through the heat of combustion and not the reactivity A theory of combustion noise based upon the flame radiating to open surroundings is able to reasonably explain the observed results A thermoacoustic efficiency for noise radiation as high as 00003 was observed in this program for JP-4 fuel Scaling rules are presented for installed configurations Author

N76-10124*# Pratt and Whitney Aircraft East Hartford Conn
EXPERIMENTAL CLEAN COMBUSTOR PROGRAM, PHASE 1 Final Report
R Roberts A Peduzzi, and G E Vitti Oct 1975 214 p refs
(Contract NAS3-16829)
(NASA-CR-134736 PWA-5153) Avail NTIS HC $7 25 CSCL 12E

A program of screening three low emission combustors for conventional takeoff and landing by testing and analyzing thirty-two configurations is presented Configurations were tested that met the emission goals at idle operating conditions for carbon monoxide and for unburned hydrocarbons (emission index values of 20 and 4 respectively) Configurations were also tested that met a smoke number goal of 15 at sea-level take-off conditions None of the configurations met the goal for oxides of nitrogen emissions at sea-level take-off conditions The best configurations demonstrated oxide of nitrogen emission levels that were approximately 61 percent lower than those produced by the JT9D-7 engine but these levels were still approximately 24 percent above the goal of an emission index level of 10 Additional combustor performance characteristics including lean blowout exit temperature pattern factor and radial profile pressure loss altitude stability and altitude relight characteristics were documented The results indicate the need for significant improvement in the altitude stability and relight characteristics In addition to the basic program for current aircraft engine combustors seventeen combustor configurations were evaluated for advanced supersonic technology applications The configurations were tested at cruise conditions and a conceptual design was evolved Author

N76-10125*# General Electric Co Cincinnati Ohio
DESIGN, FABRICATION AND ACOUSTIC TESTS OF A 36 INCH (0 914 METER) STATORLESS TURBOTIP FAN Final Contract Report
E G Smith D L Stempert and W R Uhl Washington NASA Sep 1975 184 p refs
(Contract NAS2-5462)
(NASA-CR-2597 R74AEG334) Avail NTIS HC $7 00 CSCL 21E

The LF336/E is a 36 inch (0 914 meter) diameter fan designed to operate in a rotor-alone configuration Design features required for modification of the existing LF336/A rotor-stator fan into the LF336/E statorless fan configuration are discussed Tests of the statorless fan identified an aerodynamic performance deficiency due to inaccurate accounting of the fan exit swirl during the aerodynamic design This performance deficiency related to fan exit static pressure levels produced about a 20 percent thrust loss A study was then conducted for further evaluation of the fan exit flow fields typical of statorless fan systems This study showed that through proper selection of fan design variables such as pressure ratio radius ratio and swirl distributions performance of a statorless fan configuration could be improved with levels of thrust approaching the conventional rotor-stator fan system Acoustic measurements were taken for the statorless fan system at both GE and NASA and when compared to other lift fan systems showed noise levels comparable to the quietest lift fan configuration which included rotor-stator spacing and acoustic treatment The statorless fan system was also used to determine effects of rotor leading edge serrations on noise generations A cascade test program identified the serration geometry based on minimum pressure losses wake turbulence levels and noise generations Author

N76-10126*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
THRUST PERFORMANCE OF ISOLATED 36-CHUTE SUPPRESSOR PLUG NOZZLES WITH AND WITHOUT EJECTORS AT MACH NUMBERS FROM 0 TO 0 45
Douglas E Harrington James J Schloemer (GE Co Cincinnati) and Stanley A Skebe Washington Oct 1975 47 p refs
(NASA-TM-X-3298, E-8334) Avail NTIS HC $3 75 CSCL 20A

Plug nozzles with chute-type noise suppressors were tested with and without ejector shrouds at free-stream Mach numbers from 0 to 0 45 and over a range of nozzle pressure ratios from 2 to 4 A 36-chute suppressor nozzle with an ejector had an efficiency of 94 6 percent at an assumed takeoff pressure ratio of 3 0 and a Mach number of 0 36 This represents only a 3 4 percent performance penalty when compared with the 98 percent efficiency obtained with a previously tested unsuppressed plug nozzle Author

N76-10127*# Advanced Technology Labs Inc Westbury N Y
STUDY OF VARIABLE CYCLE ENGINES EQUIPPED WITH SUPERSONIC FANS
Horacio Trucco Sep 1975 110 p refs
(Contract NAS3-17559)
(NASA-CR-134777 ATL-TR-201) Avail NTIS HC #5 25 CSCL 21E

Two types of variable cycle jet engines were investigated One called Variable Bypass Engine resembles a conventional bypass engine the second is called Bleed-Burn Engine and is characterized by remote supersonic fan units These engines are characterized by the utilization of a supersonic fan to energize their bypassed flow Performance calculations show that both engines exhibit substantial reduction in fuel consumption in comparison to contemporary variable cycle engines In addition these engines are smaller and of lighter installed weight Mission range for the case of a supersonic transport with 236 passenger cruising at Mach 2 70 were calculatd for these new engines The Variable Bypass Engine displays the best performance with relative reduction in takeoff gross weight of the order of 90 720 kg (200 000 lb) for the basic 7 408 km (4 000 N Mi) mission when compared to a conventional Duct Heating Turbofan Engine For the case of the Bleed-Burn Engine the same mission can be achieved with about 45 360 kg (100 000 lb) takeoff gross weight reduction These potentials warrant a more detailed and wider analysis of these engines which should assign first priority to the design and test of an applicable supersonic fan Author

N76-10128*# Pratt and Whitney Aircraft East Hartford Conn
NOISE ADDENDUM EXPERIMENTAL CLEAN COMBUSTOR PROGRAM, PHASE 1 Final Report, Dec 1973 - Jul 1974
T G Sofrin and D A Ross Oct 1975 120 p refs
(Contract NAS3-16829)
(NASA-CR-134820 PWA-5252) Avail NTIS HC $5 25 CSCL 21E

The development of advanced CTOL aircraft engines with reduced exhaust emissions is discussed Combustor noise information provided during the basic emissions program and used to advantage in securing reduced levels of combustion noise is included Results are presented of internal pressure transducer measurements made during the scheduled emissions test program on ten configurations involving variations of three basic combustor designs Author

N76-10129*# General Electric Co Cincinnati, Ohio Aircraft Engine Group
DEMONSTRATION OF SHORT-HAUL AIRCRAFT AFT NOISE REDUCTION TECHNIQUES ON A TWENTY INCH (50 8 cm) DIAMETER FAN, VOLUME 1 An Early Domestic Dissemination Report
D L Stimpert and R A McFalls Apr 1975 121 p refs 3 Vol
(Proj FEDD, Contract NAS3-18021)
(NASA-CR-134849 R75AEG252-Vol-1) Avail NASA Regional Dissemination Centers only to U S Requesters HC $5 25/MF $2 25 CSCL 21E

Scale models were tested in an anechoic chamber The various techniques employed were source noise reduction features of selection of vane-blade ratio to reduce second harmonic noise spacing effects, and lowering the Mach number through a vane row Aft suppression features were investigated which included porosity effects, variable depth treatment, and treatment regenerated flow noise Photographs of test equipment and hardware are included Author

N76-10130*# General Electric Co Cincinnati Ohio Aircraft Engine Group
DEMONSTRATION OF SHORT-HAUL AIRCRAFT AFT NOISE REDUCTION TECHNIQUES ON A TWENTY INCH (50 8 cm) DIAMETER FAN, VOLUME 2 An Early Domestic Dissemination Report
D L Stimpert Apr 1975 307 p 3 Vol
(Proj FEDD Contract NAS3-18021)
(NASA-CR-134850 R75AEG252-Vol-2) Avail NASA Regional Dissemination Centers only to U S Requesters HC $9 25/MF $2 25 CSCL 21E

The 1/3 octave band sound data are plotted for various combinations of fan speeds acoustic angles and frequencies Author

N76-10131*# General Electric Co, Cincinnati, Ohio Aircraft Engine Group
DEMONSTRATION OF SHORT-HAUL AIRCRAFT AFT NOISE REDUCTION TECHNIQUES OF A TWENTY INCH (50 8 cm) DIAMETER FAN, VOLUME 3 An Early Domestic Dissemination Report
D L Stimpert Apr 1975 725 p 3 Vol
(Proj FEDD, Contract NAS3-18021)
(NASA-CR-134851 R75AEG252-Vol-3) Avail NASA Regional Dissemination Centers only to U S Requesters HC $17 25/MF $2 25 CSCL 21E

The 1/3 octave band sound data are presented for all the configurations tested The model data are presented on 17 foot (5 2 cm) arc and extrapolated to 200 foot (60 96 m) sideline Author

N76-10133*# Pratt and Whitney Aircraft East Hartford Conn
REDESIGNED ROTOR FOR A HIGHLY LOADED, 1800 FT/SEC TIP SPEED COMPRESSOR FAN STAGE 1 AERODYNAMIC AND MECHANICAL DESIGN
J E Halle and J T Ruschak Sep 1975 68 p refs
(Contract NAS3-18020)
(NASA-CR-134835 PWA-5266) Avail NTIS HC $4 25 CSCL 21E

A highly loaded high tip-speed fan rotor was designed with multiple-circular-arc airfoil sections as a replacement for a marginally successful rotor which had precompression airfoil sections The substitution of airfoil sections was the only aerodynamic change Structural design of the redesigned rotor blade was guided by successful experience with the original blade Calculated stress levels and stability parameters for the redesigned rotor are within limits demonstrated in tests of the original rotor Author

N76-10135# Pratt and Whitney Aircraft East Hartford Conn
BOUNDARY-INTEGRAL EQUATION METHOD FOR THREE-DIMENSIONAL ELASTIC FRACTURE MECHANICS ANALYSIS Interim Scientific Report, 1 Apr 1974 - 31 Mar 1975
T A Cruse 28 May 1975 59 p refs
(Contract F44620-74-C-0060 AF Proj 9782)
(AD-A011660 PWA-5272 AFOSR-75-0813TR) Avail NTIS CSCL 11/6

Analytical and numerical modeling improvements in the three-dimensional boundary-integral equation method have been developed for fracture mechanics problems in rotating gas turbine structures for aircraft Improved modeling procedures for accurate stress intensity factor analysis of surface and corner cracks were developed and verified In addition the basic analytical stress analysis tool was extended to include analysis of the steady-state thermo-elastic and centrifugal body force problems Results reported include newly developed analytical formulations for crack analysis and body force problems Extensive numerical results are reported which verify the improved analytical capabilities GRA

N76-10137# Naval Weapons Engineering Support Activity Washington D C
STATISTICAL CALCULATION AND ANALYSIS FOR THE LOGISTICS OF ENGINE REMOVAL (SCALER) METHODOLOGY
James P Matthesen Feb 1975 81 p refs
(AD-A010824, NAVWESA-R-7502) Avail NTIS CSCL 01/3

SCALER was developed in 1973-74 for the Engine Life Management Group (ELMG) as the Navy s self-validating actuarial method of statistically projecting aircraft engine removals and rework requirements and of periodically providing management a usable analysis of removal data The method separates the effects due to administrative policy changes, statistical fluctuations changes in engine age populations and changes in engine reliability The report describes the method assumptions calculations and output reports GRA

N76-10138 Missouri Univ Rolla
DEVELOPMENT OF HELICOPTER FLIGHT PATH MODELS UTILIZING MODERN CONTROL TECHNIQUES Ph D Thesis
Alfred Fermelia 1975 134 p
Avail Univ Microfilms Order No 75-22319

The nonlinear set of equations which represents helicopter motion are linearized about a prescribed nominal state Once the linearized system is obtained it is validated by comparing the output of the nonlinear system to that of its linearized counterpart Having obtained a linear model, linear system theory may then be applied in order to investigate the stability and control characteristics of the aircraft General techniques for simulating helicopter pilot response for inclusion in a flight path simulation program have been devised To provide the desired flight goal a nominal flight trajectory is obtained from an existing nonlinear model With this basis a deterministic pilot model which attempts to minimize flight deviations from the nominal can be developed for generating descriptions of the desired flight path Dissert Abstr

N76-10139 Minnesota Univ Minneapolis
IN-FLIGHT THRUST VECTOR CONTROL Ph D Thesis
Ludo Verhavert 1975 271 p
Avail Univ Microfilms Order No 75-21100

The impact of in-flight thrust vectoring on the longitudinal stability of heavy subsonic jet transport aircraft was investigated The rigid body equations of motion for a thrust vectored aircraft are developed Longitudinal stability augmentation systems including thrust vector control are synthesized and an evaluation is made of the contribution of the thrust vector control component towards longitudinal stability augmentation and towards further relaxed static stability Dissert Abstr

N76-10140*# Aerospace Systems Inc Burlington Mass
A SPIRAL GUIDANCE APPROACH CONCEPT FOR COMMERCIAL VTOL OPERATIONS Final Report
William C Hoffman and Walter M Hollister May 1975 128 p refs
(Contract NAS1-12199)
(NASA-CR-132651 ASI-TR-75-21) Avail NTIS HC$5 75 CSCL 01C

The results of an investigation of the guidance and navigation requirements for VTOL spiral descents in the presence of winds are reported Models were developed to describe the spiral maneuver and candidate guidance laws were formulated and analyzed An important element of the guidance scheme is a unique wind estimator which uses the perturbations in bank angle and heading to improve the knowledge of the winds Finally recommendations for additional research including a flight program were outlined to evaluate the spiral guidance concept Author

N76-10141# Naval Postgraduate School Monterey Calif
A FLIGHT TEST DETERMINATION OF THE STATIC AND DYNAMIC LONGITUDINAL STABILITY OF THE CESSNA 310H AIRCRAFT M S Thesis
William Harvey Siren Jun 1975 77 p refs
(AD-A010795) Avail NTIS CSCL 01/3

An investigation was made of the static and dynamic longitudinal stability of a Cessna 310H aircraft Stick-fixed and stick-free neutral points were determined for both the cruise and approach configurations Stick-fixed and stick-free maneuver points were determined for the cruise configuration Values of the neutral points and maneuver points were also obtained from a theoretical analysis for comparison purposes The longitudinal long period or phugoid mode was investigated for the stick-fixed and stick-free cases and for widely separated center of gravity locations GRA

N76-10144# Eidgenossisches Flugzeugwerk Emmen (Switzerland)
CALCULATION OF THE DISPLACEMENT CORRECTION (SOLID BLOCKING) TO RUMP AND WING FOR ARBITRARY RECTANGULAR WIND TUNNELS PART 1 THEORY
M Schleicher 2 Jul 1974 30 p refs In GERMAN
(Proj 10 3/230-56)
(CH-6032-Emmen, FO-1230) Avail NTIS HC $3 75

Methods for calculating displacement corrections to rump and wings are discussed It is stipulated that angle of incidence and angle of sideslip are always at zero degree in a potential flow A special rotational ellipsoid approximation method is developed for rump calculations A numerical analysis for random trapezoidal wings is formulated that considers wing thickness ratios Transl by G G

N76-10145# Eidgenossisches Flugzeugwerk Emmen (Switzerland)
CALCULATION OF THE DISPLACEMENT CORRECTION (SOLID BLOCKING) TO RUMP AND WING FOR ARBITRARY RECTANGULAR WIND TUNNELS PART 2 PROGRAM AND RESULTS
M Schleicher 8 Jul 1974 59 p refs In GERMAN
(Proj 10 3/230-56)
(CH-6032-Emmen FO-1230) Avail NTIS HC $4 25

Presented are computer programs in FORTRAN 4 that were developed from the theoretical principles contained in Part 1 Also included are some numerical results as well as tables for the displacement corrections to rumps in correlation with volumes and thickness ratios Tables relate to the large subsonic tunnel (measuring section open or closed), the small subsonic tunnel (measuring section open) and the flutter tunnel (measuring section closed) Transl by G G

N76-10157# Sanders and Thomas Inc, Pottstown Pa
AIRCRAFT DESIGN REFERENCE DATA FOR EXPEDITIONARY AIRFIELDS Final Report
27 Sep 1974 26 p refs Sponsored by the Navy
(AD-A011447 NAEC-ENG-7856) Avail NTIS CSCL 01/5

A description of expeditionary airfields and associated components is presented to familiarize aircraft designers with the expeditionary aircraft concept An expeditionary airfield is a complete airfield that can be transported and assembled easily and have the capability to launch, recover and support certain high performance tactical jet aircraft The report provides necessary design parameters to insure that future aircraft have expeditionary airfield operating capability GRA

N76-10530# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
DETERMINATION OF THE FATIGUE LIFE OF STRUCTURAL ELEMENTS DURING THE BIHARMONIC PROCESS OF LOADING
G G Zaveryukha 15 Jan 1975 53 p refs Transl into ENGLISH from Tsentr Aerogidrodinam Inst Uch Zap (USSR) v 4 no 2 1973 p 85-96
(AD-A007179 FTD-MT-24-0285-75) Avail NTIS CSCL 11/6

The experimental data are given on the fatigue life of structural elements made from alloys AK4-1T1 and VAD-23 during the biharmonic process of loading with different frequencies and amplitudes Calculations of fatigue life are presented GRA

N76-10845# School of Aerospace Medicine Brooks AFB, Tex
THE TRANSMISSION, ABSORPTION COEFFICIENT, AND INDEX OF REFRACTION OF THE B-1 AND FB-3 WINDSCREENS Interim Report, 15 Jan - 15 Sep 1974
Edward F Maher and Robert E Wynn Feb 1975 49 p refs
(AF Proj 6301)
(AD-A007040 SAM-TR-75-3) Avail NTIS CSCL 01/3

Spectral characteristics were measured on the B-1, and two types of FB-111 windscreens in the spectral region of 0 3 - 2 0 micrometers The total transmission index of refraction dispersion and Lambert absorption coefficients were determined to quantitate the effective protection offered by these windscreens to high-intensity radiation Total windscreen transmission measurements were performed spectrophotometrically with each sample in normal incidence and adjacent to the detection aperture allowing both the direct transmission and the forward scatter to be measured The index of refraction for each windscreen was measured using a laser spectrometer system The index of refraction at eight wavelengths in the visible spectrum was accurately determined with this system Finally a method is presented to calculate the light attenuation offered by the three windscreens to this region of spectral radiation at various angles of incidence GRA

N76-10907# Army Aviation Systems Command St Louis, Mo Systems Analysis Office
AVSCOM'S SPARE PARTS BREAKOUT STUDY
Mark E Barkeley and Alan R LeMay Jun 1975 94 p refs
(AD-A011245, AMSAV-D-75-4, USAAVSCOM-TR-75-20) Avail NTIS CSCL 15/5

The report is delimited to the AVSCOM Spare Parts Breakout Program, with materiel considerations being restricted to those items which are on the demand stockage list (DSL), authorized stockage list (ASL) and select others The objectives of the study are the following Evaluate the current practices and procedures of the Spare Parts Breakout Program for areas of improvement, determine whether potential resource savings can be realized from the Spare Parts Breakout Program GRA

N76-10909# Assistant Secretary of Defense (Program Analysis and Evaluation), Washington, D C

ACCEPTANCE RATES AND TOOLING CAPACITY FOR SELECTED MILITARY AIRCRAFT

Oct 1974 108 p

(AD-A011501) Avail NTIS CSCL 01/3

This paper presents the detailed data for certain military aircraft used in a study of planned and actual production rates prepared by OASD (Program Analysis and Evaluation) for the Secretary of Defense The study objective was to determine the degree of optimism in Service planning and its impact on production of aircraft The conclusions are summarized under the following heads Initial buildup maximum production rate tooling capacity average production rates, and production span Eighteen Navy and Air Force aircraft programs were used as the basis for the analysis GRA

N76-10910# Michigan Univ, Ann Arbor Dept of Industrial and Operations Engineering

AIRCRAFT ENGINES DEMAND FORECASTING AND INVENTORY REDISTRIBUTION Final Report, 15 May 1973 - 15 Mar 1974

Herbert P Galliher and Richard C Wilson Feb 1975 152 p refs

(Contract F33615-73-C-4158)

(AD-A011595 ARL-75-0008) Avail NTIS CSCL 21/5

Using historical experience with J79 engines, an investigation was made of the quantitative relationships between engine age, utilization overhaul-rate failure-rate, and fleet age-distribution Based upon these considerations a new computerized method for forecasting demand for spare engines is proposed to replace present AFM 400-1 procedures A procedure for redistributing multi-indentured stocks of repairable components and assemblies from depot to base is proposed The procedure requires forecasts of removal rates, base-to-depot return rates, MOD-METRIC-like stock-allocation levels repair and ship times as inputs Whenever a stock unit becomes available at the depot or is required at a base the procedure determines in real time a stock allocation which seeks to minimize long-run expected system backorders GRA

N76-10979# *European Space Agency, Paris (France)*

LA RECHERCHE AEROSPATIALE BIMONTHLY BULLETIN NO 1974-5

Jul 1975 171 p refs Transl into ENGLISH of La Rech Aerospatiale Bull Bimestriel (Paris) no 1974-5 Sep - Oct 1974 p 247-326 Original French report available from ONERA, Paris 20 F

(ESA-TT-181) Avail NTIS HC $6 25

Topics covered are (1) numerical calculation of linearized subsonic flows around wings (2) procedure for calculating the transonic field of convergent ejectors having the shape of truncated cone bodies of revolution, (3) comparative study of two protection methods for super alloys i e the case of NiAl-type coatings on 1N-100 alloys, (4) explicit form of the optimal piloting law for a rigid aircraft flying in a turbulent atmosphere (5) evaluation of the stress intensity factor by direct measurements on a loaded cracked structure and (6) influence of sloshing in wing tip tanks on the natural vibration modes of an aircraft

N76-10980 European Space Agency Paris (France)

THE NUMERICAL CALCULATION OF LINEARIZED SUBSONIC FLOWS AROUND WINGS

Henri Viviand and Walid Chazzi *In its* La Rech Aerospatiale Bimonthly Bull No 1974-5 (ESA-TT-181) Jul 1975 p 1-29 refs Transl into ENGLISH from La Rech Aerospatiale, Bull Bimestriel (Paris) no 1974-5 Sep - Oct 1974 p 247-260

A collocation method which was proposed for the solution of a lifting problem belongs to the general class of finite element methods and presents some advantages over Multhopp methods from the point of view of simplicity and generality Numerical examples are presented and compared with theoretical and experimental results Author (ESA)

N76-10983 European Space Agency Paris (France)

EXPLICIT FORM OF THE OPTIMAL PILOTING LAW OF A RIGID AIRCRAFT FLYING IN TURBULENCE

Gabriel Coupry *In its* La Rech Aerospatiale Bimonthly Bull No 1974-5 (ESA-TT-181) Jul 1975 p 90-114 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1974-5 Sep - Oct 1974 p 291-302

After having shown the differences in principle and in application range corresponding to flight control in tubulence by open loop and closed loop the former method was developed The piloting laws are presented in an explicit form as a function of flight velocity and of the aircraft dimensionless parameters, and the response attenuation is calculated Lastly and application of the method shows which gains may be obtained by using an open loop control for the flight in turbulence of a Mirage 3 aircraft Author (ESA)

N76-10985 *European Space Agency Paris (France)*

INFLUENCE OF SLOSHING IN WING TIP TANKS ON THE VIBRATION NATURAL MODES OF AN AIRCRAFT

Roger Valid and Roger Ohayon *In its* La Rech Aerospatiale Bimonthly Bull No 1974-5 (ESA-TT-181) Jul 1975 p 151-165 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1974-5 Sep - Oct 1974 p 319-325

A calculation method is presented that predicts fluid effects on flight stability This method is based either on the fluid finite-element method and the use of a selective criterion to introduce the actually perturbating sloshing modes or on the use of a step-by-step method in which only the perturbation acting on previously chosen modes is calculated Author (ESA)

N76-10989 European Space Agency Paris (France)

PYROTECHNIC BONKERS FOR THE INFLIGHT TESTING OF STRUCTURES

Pierre Larue Maurice Millett and Gerard Piazzoli In its La Rech Aerospatiale Bimonthly Bull No 1974-3 (ESA-TT-183) Aug 1975 p 50-75 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1974-3 May - Jun 1974 p 137-146

Following a brief review of the principle of the aeroelastic *test method employed the geometrical and mass characteristics of three recently developed types of pyrotechnic pulse generators* are cited together with their performances The three devices are, respectively a flat pulse generator with a thrust of 50 daN lasting 22 msec a pulse generator consisting of laminated elements with a thrust of 175 daN lasting 26 msec and a cylindrical shaped pulse generator with a thrust of 20 daN lasting 18 msec A program of acceptance tests for these pulse generators is described as well as some modifications of the generator design to produce generator types suitable for low frequency vibration tests Author (ESA)

N76-10995*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

OPTIMAL CONTROL ALLEVIATION OF TILTING PROPROTOR GUST RESPONSE

Wayne Johnson Aug 1975 27 p refs Prepared in cooperation with Army Air Mobility R and D Lab Moffett Field, Calif

(NASA-TM-X-62494, A-6307) Avail NTIS HC $4 00 CSCL 01B

Optimal control theory is applied to the design of a control system for alleviation of the gust response of tilting proprotor aircraft Using a proprotor and cantilever wing analytical model the uncontrolled and controlled gust response is examined over *the entire operating range of the aircraft except for hover* helicopter mode, conversion, and airplane mode flight Substantial improvements in the loads ride quality and aeroelastic stability are possible with a properly designed controller A single controller, nominally optimal only at the design point speed (160 knots here), operated efficiently over the entire speed range, with the possible *exception of very low speed in helicopter mode* Kalman-Bucy filters were used as compensation networks to provide state estimates from various measurements in the wing motion, rotor speed perturbation and tip-path-plane tilt Author

N76-10996*# National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif

AN ECONOMIC STUDY OF AN ADVANCED TECHNOLOGY SUPERSONIC CRUISE VEHICLE

Cynthia L Smith and Louis J Williams Oct 1975 34 p refs (NASA-TM-X-62499 A-6333) Avail NTIS HC $4 00 CSCL 01C

A description is given of the methods used and the results of an economic study of an advanced technology supersonic cruise vehicle This vehicle was designed for a maximum range of 4000 n mi at a cruise speed of Mach 2 7 and carrying 292 passengers The economic study includes the estimation of aircraft unit cost, operating cost, and idealized cash flow and discounted cash flow return on investment In addition, it includes a sensitivity study on the effects of unit cost, manufacturing cost production quantity, average trip length, fuel cost, load factor, and fare on the aircraft's economic feasibility Author

N76-10997*# Kansas Univ, Lawrence

PROCEEDINGS OF THE NASA, INDUSTRY, UNIVERSITY, GENERAL AVIATION DRAG REDUCTION WORKSHOP

Jan Roskam ed 1975 454 p refs Conf held at Kansas Univ, Lawrence, 14-16 Jul 1975
(Grant NsG-1175)
(NASA-CR-145627) Avail NTIS HC $12 00 CSCL 01A

The conference on drag reduction research aims to improve general aviation aircraft performance

N76-10998* National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif

GENERAL OVERVIEW OF DRAG

S A Anderson *In* Kansas Univ Proc of the NASA, Ind Univ, Gen Aviation Drag Reduction Workshop 1975 p 11-37 refs
CSCL 01A

The state-of-the-art on aerodynamic drag reduction is briefly reviewed The various elements making up the total drag of an aircraft include fuselage wing, nacelles trim, interference tail and cooling drag G G

N76-10999* North Carolina State Univ Raleigh

PROSPECTS AND TIME TABLES FOR ANALYTICAL ESTIMATION OF THE DRAG OF COMPLETE AIRCRAFT CONFIGURATION

Frederick O Smetana *In* Kansas Univ Proc of the NASA, Ind, Univ, Gen Aviation Drag Reduction Workshop 1975 p 39-41 refs
CSCL 01A

Analytical drag methods and wind tunnel evaluation of aircraft design features are used to identify excessive drag of general aviation aircraft with reciprocating engines G G

N76-11000* National Aeronautics and Space Administration Langley Research Center, Langley Station Va

SUMMARY OF DRAG CLEAN-UP TESTS IN NASA LANGLEY FULL-SCALE TUNNEL

Marion O McKinney *In* Kansas Univ Proc of the NASA Ind Univ Gen Aviation Drag Reduction Workshop 1975 p 43-60 refs
CSCL 01A

This summary of drag results presents tabulations on fighter aircraft and light twin general aviation aircraft wind tunnel tests The figures show that the friction drag for light twins is larger than that for the fighters because of the greater wetted area and the smaller wing area used for reference Full scale tunnel tests developed the following design features contributing to excessive drag cooling flow system, engine exhaust stacks landing gears, control surface gaps and wing irregularities and leakages G G

N76-11001* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

SIMPLIFIED THEORETICAL METHODS FOR AERODYNAMIC DESIGN

Jan R Tulinius *In* Kansas Univ Proc of the NASA, Ind, Univ Gen Aviation Drag Reduction Workshop 1975 p 61-76 refs
CSCL 01C

The objective of this paper is to describe theoretical procedures which can be utilized by the general aviation industry for aerodynamic design Discussed are the design process and theoretical methods used to design a wing Then theoretical methods for estimating the interference velocities due to fuselage or other bodies and nacelles are elaborated It is assumed that flow fields due to different components can be superimposed, and then the pressure coefficients computed from the Bernoulli equation Methods to estimate the induced, viscous form and compressible drags are also discussed In addition a procedure for modifying the surface contours to reduce adverse pressure distributions induced by component interference is detailed Author

N76-11002* National Aeronautics and Space Administration Langley Research Center Langley Station Va

DRAG REDUCTION BACK TO BASICS

Oran W Nicks *In* Kansas Univ Proc of the NASA, Ind Univ Gen Aviation Drag Reduction Workshop 1975 p 77-85 refs
CSCL 01C

Aeronautical design engineering for general aviation aircraft considers the iteration of wind tunnel test data are lift, weight drag and thrust as the basic balancing factor in drag reduction efforts G G

N76-11003* Kansas Univ Lawrence

SOME COMMENTS ON FUSELAGE DRAG

Jan Roskam *In its* Proc of the NASA, Ind, Univ, Gen Aviation Drag Reduction Workshop 1975 p 87-102 refs

CSCL 01A

The following areas relating to fuselage drag are considered (1) fuselage fineness - ratio and why and how this can be selected during preliminary design (2) windshield drag (3) skin roughness and (4) research needs in the area of fuselage drag Author

N76-11004* Beech Aircraft Corp Wichita, Kans

PROPELLER BLOCKAGE RESEARCH NEEDS

R R Tumlinson *In* Kansas Univ Proc of the NASA Ind Univ, Gen Aviation Drag Reduction Workshop 1975 p 103-105 refs
CSCL 01C

The effect of mutual propeller/nacelle of fuselage interference on aircraft propulsive efficiency is studied in order to determine accurate drag levels from flight test data by accurately estimating installed thrust and drag and the resulting aircraft performance G G

N76-11005* Massachusetts Inst of Tech Cambridge

PRESERVATION OF WING LEADING EDGE SUCTION AT THE PLANE OF SYMMETRY AS A FACTOR IN WING-FUSELAGE DESIGN

E Eugene Larrabee *In* Kansas Univ Proc of the NASA Ind, Univ Gen Aviation Drag Reduction Workshop 1975 p 107-115 refs
CSCL 01A

Most fuselage geometries cover a portion of the wing leading edge near the plane of symmetry and it seems reasonable to expect that a large fraction of the leading edge suction which would be developed by the covered wing at high angles of attack is not developed on the fuselage This is one of the reasons that the Oswald span efficiency factor for the wing body combination fails to approach the value predicted by lifting line theory for the isolated wing Some traditional and recent literature on wing-body interference is discussed and high Reynolds number data on wing-body-nacelle drag are reviewed An exposed central leading edge geometry has been developed for a sailplane configuration Low Reynolds number tests have not validated the design concept Author

N76-11006* Virginia Polytechnic Inst and State Univ Blacksburg
ASYMPTOTIC ANALYTICAL METHODS IN FLUID MECHANICS RELATED TO DRAG PREDICTION
G R Inger *In* Kansas Univ Proc of the NASA, Ind, Univ Gen Aviation Drag Reduction Workshop 1975 p 117-124 refs
CSCL 20D

Some recent theoretical work of a purely analytical nature is described which promises to provide engineering predictions for the important drag-related phenomena of flow in the stall regime This analytical work deals with rigorous asymptotic studies of the complete Navier-Stokes equations that govern the viscous flow around any aerodynamic body under conditions where boundary layer separation takes place from the body surface Author

N76-11007* Gates Learjet Corp, Denver, Colo
THE ECONOMIC IMPACT OF DRAG IN GENERAL AVIATION
Ron D Neal *In* Kansas Univ Proc of the NASA, Ind Univ, Gen Aviation Drag Reduction Workshop 1975 p 125-135 refs
CSCL 01C

General aviation aircraft fuel consumption and operating costs are closely linked to drag reduction methods Improvements in airplane drag are envisioned for new models their effects will be in the 5 to 10% range Major improvements in fuel consumption over existing turbofan airplanes will be the combined results of improved aerodynamics plus additional effects from advanced turbofan engine designs G G

N76-11008* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
SOME METHODS FOR REDUCING WING DRAG AND WING-NACELLE INTERFERENCE
Thomas C Kelly *In* Kansas Univ Proc of the NASA Ind, Univ, Gen Aviation Drag Reduction Workshop 1975 p 137-156 refs
CSCL 01C

Primary efforts directed toward drag reduction centered on the design of both supercritical and subcritical families of airfoils the reduction of induced drag through the use of vortex diffusers, and the reduction of interference drag for executive-type aircraft Author

N76-11009* Kansas Univ Lawrence
DRAG REDUCTION THROUGH HIGHER WING LOADING
David L Kohlman *In its* Proc of the NASA Ind Univ, Gen Aviation Drag Reduction Workshop 1975 p 157-169 refs
CSCL 01C

A reduction in wing area, thickness and span increases wing loading and lowers parasitic drag for a typical light airplane by 10 5% G G

N76-11010* National Aeronautics and Space Administration Flight Research Center Edwards Calif
USE OF A PITOT PROBE FOR DETERMINING WING SECTION DRAG IN FLIGHT
Edwin J Saltzman *In* Kansas Univ Proc of the NASA Ind Univ Gen Aviation Drag Reduction Workshop 1975 p 171-189 ref
CSCL 01D

A wake traversing probe was used to obtain section drag and wake profile data from the wing of a sailplane The transducer sensed total pressure defect in the wake as well as freestream total pressure on both sides of the sensing element when the probe moved beyond the wake Profiles of wake total pressure defects plotted as a function of distance above and below the trailing edge plane were averaged for calculating section drag coefficients for flights at low dynamic pressures G G

N76-11011* Beech Aircraft Corp, Wichita, Kans
AN APPLICATION OF THE OGEE TIP
Jerald M Vogel *In* Kansas Univ Proc of the NASA Ind, Univ Gen Aviation Drag Reduction Workshop 1975 p 191-202 refs
CSCL 01C

Wind tunnel tests show that the aerodynamic performance of a rectangular 3-D wing is increased by changing its tip to an ogee shape Potential gains in both cruise and climb performances for a modified Beech Baron aircraft indicate that incremental changes in performance are on the order of the data scatter associated with applied flight test techniques G G

N76-11012* Wichita State Univ Kans
WING-TIP VANES AS VORTEX ATTENUATION AND INDUCED DRAG REDUCTION DEVICES
W H Wentz Jr and M G Nagati *In* Kansas Univ Proc of the NASA, Ind Univ Gen Aviation Drag Reduction Workshop 1975 p 203-214 refs
CSCL 01C

Analytical studies have been conducted to examine the feasibility of utilizing wing tip turbines to remove swirl from the wing trailing vortex and hence reduce the potential for upset of following aircraft Energy recovery from the turbines is also analyzed A computer routine has been developed to permit rapid parametric studies of various tip turbine designs It is shown that the optimum turbine is a non-rotating set of vanes which reduce swirl and recover energy in the form of reduced overall configuration induced drag A specific case study indicates a 23% reduction in induced drag for a rectangular wing of aspect ratio 5 33 operated at a lift coefficient at 1 0 Author

N76-11013* Kansas Univ Lawrence
WING TIP VORTEX DRAG
Vincent U Muirhead *In its* Proc of the NASA, Ind Univ Gen Aviation Drag Reduction Workshop 1975 p 215-233 refs
CSCL 01A

Optimization of L/D through minimizing induced drag through a detailed flow study together with force, pressure and vorticity measurements is considered Flow visualization with neutral helium bubbles provides an excellent means of observing the effects of configuration changes Author

N76-11014* Gates Learjet Corp, Denver Colo
OVERVIEW OF EXTERNAL NACELLE DRAG AND INTERFERENCE DRAG
Ronald D Neal *In* Kansas Univ Proc of the NASA, Ind Univ Gen Aviation Drag Reduction Workshop 1975 p 235-244 refs
CSCL 01A

A historical view of multi-jet engine installations is given that emphasizes integration of the powerplant and the airframe in aircraft design for improved reduction in external nacelle drag and interference drag characteristics G G

N76-11015* AiResearch Mfg Co Phoenix, Ariz
INSTALLATION DRAG CONSIDERATIONS AS RELATED TO TURBOPROP AND TURBOFAN ENGINES
G A Burnett *In* Kansas Univ Proc of the NASA Ind Univ Gen Aviation Drag Reduction Workshop 1975 p 245-256
CSCL 21E

Some of the specific areas associated with straight jet and turboprop engine installations are outlined where drag reduction and thus improved aircraft system performance is obtained Specific areas constitute air intake sizing for general aviation aircraft exhaust duct geometries and cooling system arrangements for propeller powered aircraft G G

N76-11016* North Carolina State Univ Raleigh
NACELLE DRAG REDUCTION AN ANALYTICALLY-GUIDED EXPERIMENTAL PROGRAM
Frederick O Smetana *In* Kansas Univ Proc of the NASA Ind Univ Gen Aviation Drag Reduction Workshop 1975 p 257-261 ref
CSCL 01A

Modifications are proposed to standard estimating procedures, as well as the BODY computer program which predict that the drag of two nacelles will equal the drag of the fuselage A preliminary computer analysis that considers increased dimensions for the nacelle forebody so that the noise is relatively less blunt indicates a reduction in form drag much greater than the increase in skin friction drag attributable to increased surface area G G

N76-11017* Mississippi State Univ, State College
AN EXPLORATORY INVESTIGATION OF THE COOLING DRAG ASSOCIATED WITH GENERAL AVIATION PROPULSIVE SYSTEMS
E J Cross *In* Kansas Univ Proc of the NASA, Ind, Univ Gen Aviation Drag Reduction Workshop 1975 p 263-272

(Grant NsG-1083)
CSCL 01A

A systematic investigation of the drag associated with cooling air flow in contemporary general aviation engine installations is proposed Theoretical and experimental methods include a state-of-the-art survey, determination of cooling drag by flight tests, and establishment of relative magnitude and components of cooling drag G G

N76-11018* Massachusetts Inst of Tech Cambridge
PROPELLERS OF MINIMUM INDUCED LOSS, AND WATER TUNNEL TESTS OF SUCH A PROPELLER
E E Larrabee *In* Kansas Univ Proc of the NASA, Ind Univ, Gen Aviation Drag Reduction Workshop 1975 p 273-293 refs
CSCL 01C

The fundamental vortex theory for a single rotation propeller with a finite number of blades is reviewed The theory leads to the specification of a radial distribution of bound circulation on each blade for minimum induced loss analogous to the elliptic spanwise distribution of bound circulation on a wing for minimum induced drag A propeller designed in accord with this theory has been tested in a water tunnel where it exhibited high efficiency in spite of localized cavitating flow A knowledge of the flow field for an optimum propeller is of value to the airframe designer seeking to maximize the performance of the airplane-propeller combination Author

N76-11019* Kansas Univ Lawrence
SOME COMMENTS ON TRIM DRAG
Jan Roskam *In its* Proc of the NASA, Ind, Univ, Gen Aviation Drag Reduction Workshop 1975 p 295-305 refs

CSCL 01A

A discussion of data of and methods for predicting trim drag is presented Specifically the following subjects are discussed (1) economic impact of trim drag (2) the trim drag problem in propeller driven airplanes and the effect of propeller and nacelle location, (3) theoretical procedures for predicting trim drag, and (4) research needs in the area of trim drag Author

N76-11020* Virginia Polytechnic Inst and State Univ Blacksburg
REDUCTION OF TRIMMED DRAG
F H Lutze, Jr *In* Kansas Univ Proc of the NASA Ind, Univ Gen Aviation Drag Reduction Workshop 1975 p 307-318 refs
CSCL 01C

Methods are reported for reducing the aircraft drag coefficient for a given aircraft lift coefficient or speed The emphasis is placed in determining the load distribution between the wing-body combination and the tail which reduces overall drag coefficient Furthermore a technique is presented which allows the determination of various aerodynamic and geometric parameters to permit the best location to satisfy inherent stability requirements Included in the method is the calculation of sensitivity coefficients which indicate the importance of various parameters in achieving specified goals Preliminary results indicate that such an approach is feasible Author

N76-11021* Massachusetts Inst of Tech Cambridge
TRIM DRAG IN THE LIGHT OF MUNK'S STAGGER THEOREM
E E Larrabee *In* Kansas Univ Proc of the NASA Ind, Univ Gen Aviation Drag Reduction Workshop 1975 p 319-329 refs
CSCL 01A

Munk s stagger theorem holds that the induced drag of a multiplane is independent of the streamwise position (the stagger) of its lifting elements so long as the gap/span ratios and the element/element lift ratios are specified In particular, a monoplane-tailplane or a monoplane-foreplane (canard) arrangement can be regarded as a biplane of zero gap and the trim drag due to tailplane download or foreplane upload can be readily calculated The trim drag penalty is the same for both configurations Relations are given for trim drag estimates for various practical arrangements Author

N76-11022* Beech Aircraft Corp, Wichita, Kans
COST CONSIDERATION FOR AIRCRAFT CONFIGURATION CHANGES, 1
R R Tumlinson *In* Kansas Univ Proc of the NASA Ind, Univ, Gen Aviation Drag Reduction Workshop 1975 p 331-335

CSCL 01C

The costs of improvements in aircraft drag reduction design changes are outlined in the context of production decisions A drag reduction design with increased airframe weight requires cost increases for direct labor overhead and direct expenses, plus general and administrative expenses G G

N76-11023* Kansas Univ Lawrence
DRAG OF THE COMPLETE CONFIGURATION AERODYNAMIC CONSIDERATIONS, 2
Jan Roskam *In its* Proc of the NASA, Ind, Univ, Gen Aviation Drag Reduction Workshop 1975 p 337-351 refs

CSCL 01A

A number of drag items are related to the performance of a complete aircraft configuration First the effect of fuselage camber wing and nacelle incidence are discussed from a viewpoint of design decision making Second the effect of overall cruise drag on the design gross and empty weight of the airplane is discussed Examples show that cruise drag can have a very important influence on total airplane weight Third the effects of usable cruise lift-to-drag ratio and wing loading are shown to be important Finally several research needs relating to design of the complete configuration are reviewed Author

N76-11024* Gates Learjet Corp Denver, Colo
LEARJET MODEL 25 DRAG ANALYSIS
Richard Ross and Ronald D Neal *In* Kansas Univ Proc of the NASA, Ind Univ Gen Aviation Drag Reduction Workshop 1975 p 353-363
CSCL 01C

Procedures and data for estimating drag were used to calculate the drag characteristics of the Model 25 airplane Based on cruise flight test data obtained on the Model 25, these methods generally predicted the total drag characteristics within current acceptable and reasonable engineering accuracy Author

N76-11025* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
PROBLEMS IN PROPULSION SYSTEM INTEGRATION
W Henderson and J Runckel *In* Kansas Univ Proc of the NASA, Ind, Univ Gen Aviation Drag Reduction Workshop 1975 p 365-385 refs
CSCL 21E

Jet engine components are considered that influence propulsion system integration on the airframe and related aircraft drag areas Emphasis is placed on high Mach number inlet geometries, boattailed nozzle configurations propulsive wing installation wing surface blowing lift fuselage mounted nacelles, and thrust reversal G G

N76-11026* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
PROPULSION AIRFRAME INTEGRATION
D Mikkelson *In* Kansas Univ Proc of the NASA Ind, Univ Gen Aviation Drag Reduction Workshop 1975 p 387-402
CSCL 01C

Wind tunnel simulation tests are reported that utilize a 20 inch powered nacelle for airframe integration studies Considered are effects of boattail positioning, nacelle size aft fuselage drag over-the-wing half span model installation, and turboprop and ducted fan configurations G G

N76-11027* Mississippi State Univ State College
DETERMINATION OF THE LEVEL FLIGHT PERFORMANCE OF PROPELLER-DRIVEN AIRCRAFT
E J Cross *In* Kansas Univ Proc of the NASA Ind, Univ, Gen Aviation Drag Reduction Workshop 1975 p 403-407 refs
CSCL 01C

A flight test method to determine the level flight performance of propeller driven aircraft is reported that measures the amount of power it takes to overcome a known increment of added drag to maintain steady state flight conditions to determine overall drag and propeller efficiency of a general aviation aircraft Author

N76-11028* Purdue Univ, Lafayette, Ind
POSSIBLE APPLICATIONS OF SOARING TECHNOLOGY TO DRAG REDUCTION IN POWERED GENERAL AVIATION AIRCRAFT
John H McMasters and George M Palmer *In* Kansas Univ Proc of the NASA, Ind, Univ, Gen Aviation Drag Reduction Workshop 1975 p 409-430 refs
CSCL 01C

A brief examination of the performance figures achieved by modern soaring machines and a little reflection on the often huge disparity in L/D values between sailplanes and GA aircraft indicates that careful attention to lessons learned in sailplane design and manufacture hold realistic promise for substantial gains in the aerodynamic efficiency of several GA types Author

N76-11029* Massachusetts Inst of Tech Cambridge
MINIMUM VERTICAL TAIL DRAG
E E Larrabee *In* Kansas Univ Proc of the NASA Ind Univ, Gen Aviation Drag Reduction Workshop 1975 p 43-446
CSCL 01A

Tail size requirement calculations are presented for a vertical tail performing a coordinated turn reversal at corresponding load requirements with minimum tail drag G G

N76-11030*+ National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
FLOW VISUALIZATION OF VORTEX INTERACTIONS IN MULTIPLE VORTEX WAKES BEHIND AIRCRAFT
D L Ciffone and C Lonzo, Jr Jun 1975 60 p refs Original contains color illustrations
(NASA-TM-X-62459, A-6193) Avail NTIS HC $4 50 CSCL 01A

A flow visualization technique was developed which allows the nature of lift-generated wakes behind aircraft models to be investigated The technique was applied to models being towed underwater in a ship model basin Seven different configurations of a small-scale model of a 747 transport aircraft were used to allow observation of typical vortex interactions and merging in multiple vortex wakes It was established that the motion of the wake vortices is often sensitive to small changes in either wing span loading or model attitude Landing gear deployement was found to cause a far-field reformation of vorticity behind a model configuration which dissipated concentrated vorticity in the near-field wake Alleviation of wake vorticity is achievable by configuring the wing span loading to cause the wake vortices to move in paths that result in their interactions and merging The vortices shed from the horizontal stabilizer always moved down rapidly into the wake and merged with the other vortices primarily the inboard flap vortices Author

N76-11031*# Transemantics Inc Washington, D C
CERTAIN PROBLEMS OF EXPERIMENTAL AERODYNAMICS
S M Gorlin ed Washington NASA Nov 1975 122 p refs Transl into ENGLISH from the book Nekotoryye voprosy eksperimentalnoy aerodinamiki, nauchnyye trudy instituta mekhaniki MGU, no 24' Moscow, Moscow University Press 1973 p 1-119
(Contract NASw-2792)
(NASA-TT-F-16565) Avail NTIS HC $5 50 CSCL 01A

Experimental results of a study of the aerodynamic characteristics at low subsonic velocities of poorly streamlined bodies having different shapes and of the flow past irregularities on the earth's surface are presented The stress and the forces acting on structures are considered as well as the influence of the shape of certain bodies on the change in flow parameters in their vicinity Author

N76-11032*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
THEORETICAL PERFORMANCE OF CROSS-WIND AXIS TURBINES WITH RESULTS FOR A CATENARY VERTICAL AXIS CONFIGURATION
Ralph J Muraca Maria V Stephens, and J Ray Dagenhart Oct 1975 85 p refs
(NASA-TM-X-72662) Avail NTIS HC $5 00 CSCL 01A

A general analysis capable of predicting performance characteristics of cross-wind axis turbines was developed, including the effects of airfoil geometry support struts, blade aspect ratio windmill solidity, blade interference and curved flow The results were compared with available wind tunnel results for a catenary blade shape A theoretical performance curve for an aerodynamically efficient straight blade configuration was also presented In addition a linearized analytical solution applicable for straight configurations was developed A listing of the computer program developed for numerical solutions of the general performance equations is included in the appendix Author

N76-11033*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
DEVELOPMENT OF A COMPUTER PROGRAM TO OBTAIN ORDINATES FOR NACA 4-DIGIT, 4-DIGIT MODIFIED, 5-DIGIT, AND 16 SERIES AIRFOILS
Charles L Ladson Nov 1975 45 p refs
(NASA-TM-X-3284, L-10375) Avail NTIS HC $4 00 CSCL 01A

A computer program developed to calculate the ordinates and surface slopes of any thickness, symmetrical or cambered NACA airfoil of the 4-digit 4-digit modified 5-digit, and 16-series airfoil families is presented The program produces plots of the airfoil nondimensional ordinates and a punch card output of ordinates in the input format of a readily available program for determining the pressure distributions of arbitrary airfoils in subsonic potential viscous flow Author

N76-11034*# Boeing Commercial Airplane Co, Seattle Wash

TRANSONIC PRESSURE MEASUREMENTS AND COMPARISON OF THEORY TO EXPERIMENT FOR AN ARROW-WING CONFIGURATION VOLUME 1: EXPERIMENTAL DATA REPORT, BASE CONFIGURATION AND EFFECTS OF WING TWIST AND LEADING-EDGE CONFIGURATION

Marjorie E Manro, Kenneth J R Manning, Thomas H Hallstaff, and John T Rogers Oct 1975 640 p refs
(Contract NAS1-12875)
(NASA-CR-132727, D6-42670-2-Vol-1) Avail NTIS HC $16 25 CSCL 01A

A wind tunnel test of an arrow-wing-body configuration consisting of flat and twisted wings, as well as a variety of leading- and trailing-edge control surface deflections, was conducted at Mach numbers from 0 4 to 1 1 to provide an experimental pressure data base for comparison with theoretical methods Theory-to-experiment comparisons of detailed pressure distributions were made using current state-of-the-art attached and separated flow methods The purpose of these comparisons was to delineate conditions under which these theories are valid for both flat and twisted wings and to explore the use of empirical methods to correct the theoretical methods where theory is deficient Author

N76-11035*# Boeing Commercial Airplane Co Seattle Wash

TRANSONIC PRESSURE MEASUREMENTS AND COMPARISON OF THEORY TO EXPERIMENT FOR AN ARROW-WING CONFIGURATION VOLUME 2 EXPERIMENTAL DATA REPORT, EFFECTS OF CONTROL SURFACE DEFLECTION

Marjorie E Manro Kenneth J R Manning, Thomas H Hallstaff, and John T Rogers Oct 1975 614 p refs
(Contract NAS1-12875)
(NASA-CR-132728 D6-42670-3-Vol-2) Avail NTIS HC $16 25 CSCL 01A

For abstract see N76-11034

N76-11036*# Boeing Commercial Airplane Co, Seattle, Wash

TRANSONIC PRESSURE MEASUREMENTS AND COMPARISON OF THEORY TO EXPERIMENT FOR AN ARROW-WING CONFIGURATION VOLUME 3 DATA REPORT, COMPARISON OF ATTACHED FLOW THEORIES TO EXPERIMENT

Marjorie E Manro, Kenneth J R Manning, Thomas H Hallstaff and John T Rogers Oct 1975 526 p refs
(Contract NAS1-12875)
(NASA-CR-132729 D6-42670-4-Vol-3) Avail NTIS HC $13 00 CSCL 01A

For abstract see N76-11034

N76-11037*# Wichita Univ Kans Aeronautical Engineering Dept

EXPERIMENTAL STUDIES OF FLOW SEPARATION AND STALLING ON TWO-DIMENSIONAL AIRFOILS AT LOW SPEEDS PHASE 2 STUDIES WITH FOWLER FLAP EXTENDED Semiannual Progress Report, 1 Jun - 30 Nov 1975

H C Seetharam and W H Wentz, Jr 30 Nov 1975 20 p refs
(Grant NGR-17-003-021)
(NASA-CR-145741) Avail NTIS HC $3 50 CSCL 01A

Results were given on experimental studies of flow separation and stalling on a two-dimensional GA(W)-1 17 percent thick airfoil with an extended Fowler flap Experimental velocity profiles obtained from a five tube probe survey with optimum flap gap and overlap setting (flap at 40 deg) are shown at various stations above below and behind the airfoil/flap combination for various angles of attack The typical zones of steady flow intermittent turbulence, and large scale turbulence were obtained from a hot wire anemometer survey and are depicted graphically for an angle of attack of 12 5 deg Local skin friction distributions were obtained and are given for various angles of attack Computer plots of the boundary layer profiles are shown for the case of the flap at 40 deg Static pressure contours are also given A GA(W)-2 section model was fabricated with 30 percent Fowler flaps and with pressure tabs YJA

N76-11038*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

AN INVESTIGATION OF THE INCREASE IN VORTEX INDUCED ROLLING MOMENT ASSOCIATED WITH LANDING GEAR WAKE

James C Patterson and Frank L Jordan Jr Nov 1975 18 p refs
(NASA-TM-X-72786) Avail NTIS HC $3 50 CSCL 01A

Flight tests were conducted to verify the results found in ground base facilities of the effect of span lift load variation as well as the vortex attentuation of the high energy jet engine exhaust through proper thrust programming During these flight tests a large increase in vortex strength was experienced as a result of extending the landing gear Tests in the Langley Vortex Research Facility indicate that the wake produced by the landing gear may possibly form an aerodynamic endplate or reflection plane at the inboard edge of each inboard flap which increases the effective aspect ratio of the flap and thereby increases the strength of the flap outer edge vortex Author

N76-11039*# National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif

A TECHNIQUE FOR ACCELERATING ITERATIVE CONVERGENCE IN NUMERICAL INTEGRATION, WITH APPLICATION IN TRANSONIC AERODYNAMICS

E Dale Martin Oct 1975 19 p refs
(NASA-TM-X-62495) Avail NTIS HC $3 50 CSCL 01A

A technique is described for the efficient numerical solution of nonlinear partial differential equations by rapid iteration In particular a special approach is described for applying the Aitken acceleration formula (a simple Pade approximant) for accelerating the iterative convergence The method finds the most appropriate successive approximations which are in a most nearly geometric sequence for use in the Aitken formula Simple examples are given to illustrate the use of the method The method is then applied to the mixed elliptic-hyperbolic problem of steady inviscid transonic flow over an airfoil in a subsonic free stream Author

N76-11040*# Virginia Univ, Charlottesville School of Engineering and Applied Science

NASA/FRC WAKE TURBULENCE FLIGHT TEST PROGRAM RIDE QUALITY ASPECTS

David A Deptula Nov 1975 36 p refs
(Grant NGR-47-005-181)
(NASA-CR-145700, Memo-403225, ESS-4032-104-75) Avail NTIS HC $4 00 CSCL 01A

To determine how much the ride quality of the Shuttle Carrier (Boeing 747) Aircraft is affected at various spoiler settings, the PEMS II (Portable Environmental Measuring System) was used to measure onboard motion during a test flight October 15 1975 The PEMS II measures acceleration in the vertical, transverse and longitudinal directions as well as angular rates of pitch, roll and yaw The data acquired by this instrument combined with an airline passenger comfort model gives an indication of how passengers would react to the motion induced by flying in a vortex alleviation configuration Author

N76-11041*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

THEORETICAL AERODYNAMICS OF UPPER-SURFACE-BLOWING JET-WING INTERACTION

C Edward Lan and James F Campbell Washington Nov 1975 50 p refs
(NASA-TN-D-7936 L-10037) Avail NTIS HC $4 00 CSCL 01A

A linear inviscid subsonic compressible flow theory is formulated to treat the aerodynamic interaction between the wing and an inviscid upper-surface-blowing (USB) thick jet with Mach number nonuniformity The predicted results show reasonably good agreement with some available lift and induced-drag data It was also shown that the thin-jet-flap theory is inadequate for the USB configurations with thick jet Additional theoretical results show that the lift and induced drag were reduced by increasing jet temperature and increased by increasing jet Mach number

Reducing jet aspect ratio while holding jet area constant caused reductions in lift induced drag and pitching moment at a given angle of attack but with a minimal change in the curve of lift coefficient against induced-drag coefficient The jet-deflection effect was shown to be beneficial to cruise performance The aerodynamic center was shifted forward by adding power or jet-deflection angle Moving the jet away from the wing surface resulted in rapid changes in lift and induced drag Reducing the wing span of a rectangular wing by half decreased the jet-circulation lift by only 24 percent at a thrust coefficient of 2
Author

N76-11042*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
FREE-FLIGHT MODEL INVESTIGATION OF A VERTICAL-ATTITUDE VTOL FIGHTER WITH TWIN VERTICAL TAILS
Sue B Grafton and Ernie L Anglin Washington Nov 1975 29 p refs
(NASA-TN-D-8089 L-10450) Avail NTIS HC $4 00

Free-flight tests were conducted in the Langley full-scale tunnel to determine the stability and control characteristics of a vertical-attitude VTOL fighter having twin vertical tails and a pivoted fuselage forebody (nose-cockpit) arrangement The flight tests included hovering flights and transition flights from hover to conventional forward flight Static force tests were also made to aid in the analysis of the flight tests The model exhibited satisfactory stability and control characteristics, and the transition from hovering flight to conventional forward flight was relatively smooth and straightforward
Author

N76-11043*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
INTRODUCTION TO THE AERODYNAMICS OF FLIGHT
Theodore A Talay Washington 1975 203 p refs
(NASA-SP-367) Avail NTIS HC $7 75 CSCL 01A

General concepts of the aerodynamics of flight are discussed Topics considered include the atmosphere fluid flow, subsonic flow effects, transonic flow supersonic flow, aircraft performance, and stability and control
J M S

N76-11044*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
LOW SPEED AERODYNAMIC CHARACTERISTICS OF A TRANSPORT MODEL HAVING 42 33 DEG SWEPT LOW WING WITH SUPERCRITICAL AIRFOIL, DOUBLE-SLOTTED FLAPS, AND T-TAIL OR LOW TAIL
Paul G Fournier Washington Nov 1975 94 p refs
(NASA-TM-X-3276 L-9957) Avail NTIS HC $5 00 CSCL 01A

A low-speed investigation was conducted in the Langley V/STOL tunnel over an angle-of-attack range of approximately 4 deg to 24 deg to determine the static longitudinal stability characteristics and high lift performance of a general research model which represented an advanced subsonic transport configuration The model had a 42 33 deg swept aspect ratio 7 05 wing with a supercritical airfoil and high lift system consisting of a leading edge device (slat or Kruger flap) and a double-slotted flap The flaps were deflected for take off and landing configurations and were not deflected for tests of the clean configuration The model was tested with the horizontal tail in either a T tail or low tail position The effects of various arrangements of flowthrough nacelles which represent a three engine configuration (two large wing-mounted nacelles and a vertical tail mounted nacelle) and a four engine configuration (four smaller wing-mounted nacelles) were determined
Author

N76-11046*# Georgia Inst of Tech Atlanta
STUDY OF VISCOUS FLOW ABOUT AIRFOILS BY THE INTEGRO-DIFFERENTIAL METHOD Final Report
James C Wu and Sarangan Sampath Oct 1975 61 p refs
(Grant NsG-1004)
(NASA-CR-145693) Avail NTIS HC $4 50 CSCL 01A

An integro-differential method was used for numerically solving unsteady incompressible viscous flow problems A computer program was prepared to solve the problem of an impulsively started 9% thick symmetric Joukowski airfoil at an angle of attack of 15 deg and a Reynolds number of 1000 Some of the results obtained for this problem were discussed and compared with related work completed previously Two numerical procedures were used an Alternating Direction Implicit (ADI) method and a Successive Line Relaxation (SLR) method Generally, the ADI solution agrees well with the SLR solution and with previous results are stations away from the trailing edge At the trailing edge station, the ADI solution differs substantially from previous results, while the vorticity profiles obtained from the SLR method there are in good qualitative agreement with previous results
Y J A

N76-11048# European Space Agency, Paris (France)
AERODYNAMICS OF AIRFOILS IN TRANSONIC FLOW
Jul 1975 299 p refs Transl into ENGLISH of 'Tragfluegel-Aerodynamik bei schallnahen Stroemungen" DGLR, Cologne Report DLR-Mitt-73-04, 1973 299 p Proc of DGLR Symp, Goettingen, West Ger, 26-27 Oct 1972 Original German report available from DFVLR, Porz West Ger 44 60 DM
(ESA-TT-175 DLR-Mitt-73-04) Avail NTIS HC $9 25

Results of investigations into transonic flows around airfoils are presented along with experimental and theoretical investigations of sweptback wings New methods of calculating shock-free flow around airfoil sections in the transonic range, and a new wind tunnel test section for transonic profiles are discussed

N76-11049 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Inst fuer Stroemungsmechanik
COMPARATIVE MEASUREMENTS ON THREE GEOMETRICALLY SIMILAR CALIBRATION MODELS OF A TRANSPORT AIRCRAFT TYPE IN THE TRANSONIC WIND-TUNNEL AT THE AVA, GOETTINGEN
W Lorenz-Meyer *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 1-27 refs Transl into ENGLISH from "Tragfluegel-Aerodynamik bei schallnahen Stroemungen" DGLR, Cologne Report DLR-Mitt-73-04, 1973 p 1-31
(DGLR-Paper-72-122)

Results are presented of 3-component measurements in the transonic wind tunnel at AVA in the Mach-number range Ma = 0 7 to 0 96 on three geometrically similar calibration models of a transport aircraft type (an ONERA project) A detailed description of the experimental conditions is given and the effects of the Reynolds number and of the accuracy of modelling were investigated Further, for particular conditions (Mach number and Reynolds number) the results obtained are compared with those measured in the wind tunnels S2MA (Modane-Avrieux) and Sigma 4 (St Cyr)
Author (ESA)

N76-11050 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Inst fuer Aerodynamik
THE CALCULATION OF THE BUFFET BOUNDARY FOR SWEPTBACK WINGS
G Redeker *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 28-81 refs Transl into ENGLISH from 'Tragfluegel-Aerodynamik bei schallnahen Stroemungen' DGLR, Cologne Report DLR-Mitt-73-04 1973 p 32-90
(DGLR-Paper-72-123)

A computational method for determining the buffet boundary of a sweptback wing in the transonic range of velocities is described Thomas's method for determining the buffet boundary for wings without sweepback or only slightly sweptback is extended to wings with marked sweepback This is done by considering an infinitely long sheared wing using the Sinnott method for calculating the transonic pressure distributions and an integral method for calculating the 3-dimensional turbulent compressible boundary-layer Theoretical calculations of the buffet boundary by these methods agree well with the experimental results for sweptback wings Author (ESA)

N76-11051 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany) Inst fuer Angewandte Gasdynamik

THEORETICAL INVESTIGATION OF TRANSITION PHENOMENA IN THE BOUNDARY LAYER ON AN INFINITE SWEPTBACK WING

E H Hirschel *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 82-101 refs Transl into ENGLISH from Tragfluegel-Aerodynamik bei schallnahen Stroemungen" DGLR, Cologne Report DLR-Mitt-73-04 1973 p 91-112

(DGLR-Paper-72-124)

The transition in compressible three-dimensional boundary layers on infinite sweptback wings was investigated by applying stability criteria and transition criteria to numerically calculated boundary layer flows The inviscid flow fields were found experimentally and represent transonic flows about airfoils with embedded supersonic regions The different criteria and their application to the boundary-layer flows are discussed The study was made under variation of the two main parameters angle of sweepback and free-stream Reynolds number Author (ESA)

N76-11052 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Inst fuer Stroemungsmechanik

ON THE EFFECT OF A STRAKE ON THE FLOW FIELD OF A DELTA WING (LAMDA EQUALS 2) AT NEAR-SONIC VELOCITIES

W Stahl *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 102-122 refs Transl into ENGLISH from 'Tragfluegel-Aerodynamik bei schallnahen Stroemungen" DGLR, Cologne Report DLR-Mitt-73-04 1973 p 113-136

(DGLR-Paper-72-125)

Experimental investigations were carried out on a delta wing with an aspect ratio lambda = 2 and on a double delta wing derived from it The flow field on the suction side of the basic delta wing with a sharp leading edge is strongly affected by the leading-edge vortices A forewing (strake) with large sweepback and sharp edges, attached to the main wing affects by its leading-edge vortices the flow field over the main wing The resulting changes in the forces, in the pressure distributions on the suction side, and in the flow field were examined at subsonic, and especially at near-sonic, velocities (Ma = 0 5 to 0 9) The vortex-breadown phenomena occurring at high angles of incidence were investigated for the wing with and without the strake Author (ESA)

N76-11053 Messerschmitt-Boelkow-Blohm G m b H , Ottobrunn (West Germany)

IMPROVEMENT OF MANEUVERABILITY AT HIGH SUBSONIC SPEEDS

W Staudacher *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 123-139 refs Transl into ENGLISH from 'Tragfluegel-Aerodynamik bei schallnahen Stroemungen , DGLR, Cologne Report DLR-Mitt-73-04, 1973 p 137-158

(DGLR-Paper-72-126)

A number of studies were carried out to improve the maneuverability of combat aircraft As a geometrically variable configuration, slotted and unslotted flaps were fitted to the leading edge and trailing edge of a pilot model, which was tested in the wind-tunnel up to transonic speeds As geometrically fixed variants of the plan shape, strakes i e modifications of the leading edge which have a large angle of sweepback were attached to the trapezoidally shaped basic wing near the wing root, and were investigated over the whole range of Mach numbers (6-component measurements were taken) By combining various aids to maneuverability, an improvement of 100% in performance in certain flight regions could be obtained as compared with the basic wing Strakes were considerably more efficient than flap systems at high angles of attack Author (ESA)

N76-11054 Technische Hochschule Darmstadt (West Germany) Inst fuer Flugtechnik

SIDE-SLIPPING AIRFOILS IN TRANSONIC FLOW

B Wagner *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 140-165 refs Transl into ENGLISH from Tragfluegel-Aerodynamik bei schallnahen Stroemungen DGLR Cologne Report DLR-Mitt-73-04, 1973 p 159-192

(DGLR-Paper-72-127)

A method was developed which takes into account the vortex sheet leaving the lateral edge of a side-slipping wing The theory of singular integral equations was used to derive an integral equation for the vorticity of the wing wake This integral equation is similar to the familiar integral equations for sweptback wings in a symmetrical transonic flow The method of solution developed can be applied to airfoils with arbitrary camber and twist The singularities in the vortex distribution at the wing apex and at the start of the wake are discussed Author (ESA)

N76-11055 Dornier-Werke G m b H Friedrichshafen (West Germany)

THE CALCULATION OF SUPERCRITICAL FLOWS ROUND AIRFOILS BY THE MURMAN-KRUPP DIFFERENCE METHOD

R Vanino *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 166-187 refs Transl into ENGLISH from "Tragfluegel-Aerodynamik bei schallnahen Stroemungen DGLR, Cologne Report DLR-Mitt-73-04 1973 p 193-223

(DGLR-Paper-72-128)

The results from the Krupp relaxation method show that this method is a useful tool in the practical design of airfoils Using a simple scheme of calculation, feasible solutions can be obtained within acceptable times by starting from the undisturbed flow Examples illustrate the wide applicability of the method which gives good results for thick airfoils with strong suction peaks, at high angles of attack Author (ESA)

N76-11056 Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Aachen (West Germany) Inst fuer Theoretische Gasdynamik

AN ANALOGUE-ANALYTICAL CONSTRUCTION FOR SUPERCRITICAL FLOWS ROUND AN AIRFOIL

H Sobieczky et al *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 188-197 refs Transl into ENGLISH from Tragfluegel-Aerodynamik bei schallnahen Stroemungen' DGLR, Cologne Report DLR-Mitt-73-04 1973 p 224-240

(DGLR-Paper-72-129)

A method is presented for solving a mixed elliptic-hyperbolic differential equation in the particular boundary-value problem of supercritical flow round an airfoil As an analog of a plane inviscid fluid flow, an electric potential flow is used From these measurements the subsonic region of the flow round the airfoil and a starting point are determined for an analytical calculation of the flow in the supersonic region With this method both shock-free flows and flows with weak shocks can be determined Author (ESA)

N76-11057 Messerschmitt-Boelkow-Blohm G m b H , Hamburg (West Germany)

RESULTS ON THE USE OF SHOCK-FREE TRANSONIC AIRFOILS FOR TRANSPORT AIRCRAFT

J Scheerer *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 198-226 refs Transl into ENGLISH from 'Tragfluegel-Aerodynamik bei schallnahen Stroemungen', DGLR, Cologne Report DLR-Mitt-73-04 1973 p 241-275

(DGLR-Paper-72-130)

Results concerning the design and calculation of supercritical profiles in order to ascertain the applicability of collisionless transonic profiles for wings of large and medium aspect ratio are discussed In order to determine whether the aerodynamic properties of these profiles can be applied to wings, test results concerning the design of straight and yawing quasi-two-dimensional wings are presented and discussed In spite of the fact that the test results are not satisfactory in every respect, the limited use of sweepback theory in the case of supercritical wings is regarded as useful for design purposes In a comparison with comparable conventional profiles an estimate is made of the separation behavior of supercritical profiles in the low-velocity range (Re equals 10,000,000) In connection with the results and experiences discussed for supercritical profiles a possibility of transonic wing design is indicated and discussed Author (ESA)

N76-11058 Aeronautical Research Inst of Sweden, Bromma
THE PREDICTION OF AIRFOIL DISTRIBUTIONS FOR SUBCRITICAL VISCOUS FLOW AND FOR SUPERCRITICAL INVISCID FLOW
A Gustavsson *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 227-245 refs Transl into ENGLISH from Tragfluegel-Aerodynamik bei schallnahen Stroemungen DGLR Cologne Report DLR-Mitt-73-04, 1973 p 276-294
(DGLR-Paper-72-131)

An approximate method is described for calculating the pressure distribution on a thick cambered airfoil in subcritical viscous flow The results obtained are compared with recent experimental results for subcritical flow conditions For supercritical inviscid flow conditions pressure distributions were calculated with two finite difference methods A comparison is made between the two methods and with recent experimental results
Author (ESA)

N76-11059 Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany)
TRANSONIC AIRFOIL THEORY A CRITICAL COMPARISON OF VARIOUS METHODS
A Eberle et al *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 246-271 refs Transl into ENGLISH from 'Tragfluegel-Aerodynamik bei schallnahen Stroemungen" DGLR, Cologne Report DLR-Mitt-73-04, 1973 p 295-328
(DGLR-Paper-72-132)

The use of theoretical methods for the design of profiles in the supercritical flow range and the employment of computation procedures for the determination of profile characteristics is discussed The results obtained with the aid of various methods are compared on the basis of an investigation covering six selected profiles Suggestions regarding the merits of the individual methods for the selection and definition of supercritical profiles are presented, and a new formulation is provided concerning the design approach for profiles with shockless compressing
Author (ESA)

N76-11060 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Inst fuer Aerodynamik
THE TRANSONIC TEST-SECTION FOR AIRFOIL MEASUREMENTS IN THE INSTITUTE FOR AERODYNAMICS, BRAUNSCHWEIG
G Kausche *In* ESA Aerodynamics of Airfoils in Transonic Flow (ESA-TT-175) Jul 1975 p 272-287 refs Transl into ENGLISH from Tragfluegel-Aerodynamik bei schallnahen Stroemungen" DGLR, Cologne Report DLR-Mitt-73-04 1973 p 329-346
(DGLR-Paper-72-133)

A proposed transonic wind tunnel for profile measurements at fairly high Reynolds numbers is described A detailed account is given of the present state of development of this tunnel, which is a reconstruction of a formerly existing supersonic wind tunnel The concept underlying the design of this tunnel is reviewed Criteria for the design of the tunnel are outlined, and the range of operation of the tunnel is discussed Author (ESA)

N76-11061# Aeronautical Research Inst of Sweden Stockholm Aerodynamics Dept
TRANSONIC AND SUPERSONIC WIND TUNNEL TESTS ON SLENDER CRUCIFORM WING-BODY-TAIL CONFIGURATIONS IN DIFFERENT PITCH AND ROLL POSITIONS Final Report
S E Gudmundson and L Torngren 1975 198 p refs
(Contracts F-INK-07-12-15 F-INK-82223-72-004)
(FFA-TN-AU-988) Avail NTIS HC $7 50

Wind-tunnel tests were performed to high angles of attack at 7 different Mach numbers between 0 7 and 3 08 and at 5 different roll angles between 0 deg and 45 deg 5-component measurements were done with 9 different model configurations a 15 diameter long cylinder body with a 1 5 diameter long ogive nose together with two different cruciform tails, two different cruciform wings alone and in combination with the body the larger cruciform wings with body and two different tails and the larger wings and tails with the wings mounted three diameters further back on the body Author (ESA)

N76-11063# European Space Agency Paris (France)
ON THE LIFTING PROBLEM OF WARPED WINGS IN SUPERSONIC FLOWS
Arabindo Das Jul 1975 62 p refs Transl into ENGLISH of "Zum Auftriebsprobl von Tragfluegeln mit Woelbung u Verwindung bei Ueberschallstroemung DFVLR Brunswick Report DLR-FB-75-10, 1975 Original German report available from DFVLR, Porz, West Ger 23 80 DM
(ESA-TT-174 DLR-FB-75-10) Avail NTIS HC $4 50

Lift distributions for minimum pressure drag require wing surfaces possessing both camber and twist For this direct problem of finding wing forms under prescribed lift distributions, a simple analytical method is presented The derivations of the approximating formulas follow directly from the general solutions of the perturbation fields in supersonic flow, in which the assumption of moderately slender wings is subsequently introduced In order to check the applicability of the approximating theory the aerodynamic characteristics of delta wings with various camber and twist were calculated and compared with the corresponding values obtained from the exact theories for higher order conical flows As a special case the treatment includes the results for plane wings without warping The calculations of wing shapes under prescribed lift distributions were performed in an obvious and simple manner Linear superposition of various basic distributions permits the generation of complex wing forms
Author (ESA)

N76-11064# European Space Agency Paris (France)
INFLUENCE OF SPLITTER WEDGES ON THE LIFT AND DRAG OF A RECTANGULAR WING WITH A BLUNT TRAILING EDGE
M Tanner Sep 1975 51 p refs Transl into ENGLISH of "Einfluss von Trennkeilen auf den Auftrieb u Widerstand eines Rechteckfluegels mit stumpfer Hinterkante" DFVLR Goettingen, West Ger Report DLR-FB-74-61 Jul 1974 Original German report available from DFVLR, Porz West Ger 16 DM
(ESA-TT-187 DLR-FB-74-61) Avail NTIS HC $4 50

Lift and drag measurements were performed on a rectangular wing with a blunt trailing edge fitted with various splitter wedges The Mach number had a value of 0 15 and the Reynolds number a value of 2 million, approximately The results show that for optimum dimensions of the splitter wedge the base drag practically vanishes Then the wing with a blunt trailing edge fitted with a splitter wedge has an equally high maximum lift to drag ratio as a conventional wing with a sharp trailing edge Author (ESA)

N76-11065# European Space Agency, Paris (France)
UNSTEADY PRESSURE MEASUREMENTS ON OSCILLATING WING/BODY COMBINATIONS COMPARISON BETWEEN THEORY AND EXPERIMENT
H Triebstein et al Sep 1975 76 p refs Transl into ENGLISH of Instationaere Druckverteilungen an schwingenden schlanken Fluegel-Rumpf-Kombinationen Vergleich zwischen Theorie u

Messung", DFVLR, Goettingen West Ger Report DLR-FB-74-47, 26 Apr 1974 Original German report available from DFVLR, Porz, West Ger 24 DM
(ESA-TT-189, DLR-FB-74-47) Avail NTIS HC $5 00
The results of unsteady pressure measurements performed on harmonically oscillating wing-body-combinations in incompressible flow are discussed The measurements were made in a subsonic wind tunnel at harmonically pitching oscillations about two different pitching axes and at rolling oscillations about the midchord on two different wing-body models with the aspect ratios lambda = 0 57 and lambda = 1 02 The flow speeds were V = 25 m/s and V = 50 m/s, and the oscillation frequencies were f = 6, 12, 18 and 24 cps The reduced frequencies ran from 0 7 to 5 8 The results of the measurements were critically compared with corresponding theoretical results of the slender-body theory Author (ESA)

N76-11067# Ohio State Univ Columbus Aeronautical and Astronautical Research Lab
HIGH REYNOLDS NUMBER TRANSONIC TESTING Final Report, 30 Jun 1971 - 30 Jun 1974
John D Lee May 1975 44 p
(Contract F33615-71-C-1911, AF Proj 7065)
(AD-A011983 ARL-75-0112) Avail NTIS CSCL 20/4
An experimental program was conducted to investigate the feasibility of using a pressurized blowdown wind tunnel to simulate transonic flows at flight Reynolds numbers A 4 inch by 10 inch channel proved to be capable of supplying essentially two-dimensional flows over airfoil models flow departure from the two-dimensional approximation occurred when shock waves terminating local flows of Mach number greater than about 1 5 caused separation of the sidewall boundary layers Simulation of the interaction between the terminal shock wave and the model boundary layer appeared to be adequate Comparisons with data from a larger wind tunnel indicated little or no interference in the subcritical flow range but a large and unpredictable induced attack angle GRA

N76-11068+ Wetenschappelijk en Technisch Documentatie- en Informatiecentrum voor de Krijgsmacht, The Hague (Netherlands) Aircraft Engineering Section
FLIGHT SAFETY BIBLIOGRAPHY, 1968 - 1974
B J J Warrink comp Jan 1975 181 p refs Partly in ENGLISH, GERMAN, FRENCH and DUTCH
(TDCK-65616) Avail NTIS HC $7 50
The 373 abstracts of articles and reports available at TDCK are presented Sources of unsafety i e mid-air collisions, meteorological and aerodynamic phenomena fog, fire, actual accidents prevention, and survivability, safety and survival equipment are the subjects covered in detail ESA

N76-11069*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
HAZARD CRITERIA FOR WAKE VORTEX ENCOUNTERS
Robert I Sammonds and Glen W Stinnett, Jr Aug 1975 45 p refs
(NASA-TM-X-62473 A-6232) Avail NTIS HC $4 00 CSCL 01A
A piloted motion-base simulation was conducted to evaluate the ability of simulators to produce realistic vortex encounters and to develop criteria to define hazardous encounters Evaluation of the simulation by pilots experienced in vortex encounters confirmed the capability of the simulator to realistically reproduce wake vortex encounters A boundary for encounter hazard based on subjective pilot opinion was identified in terms of maximum bank angle For encounter altitudes from 200 to 500 ft (61 0 to 152 4 m), tentative hazard criteria established for visual flight conditions indicated that the acceptable upset magnitude increased nearly linearly with increasing altitude The data suggest that the allowable upsets under instrument conditions no greater than 50 percent of that allowable under visual conditions Author

N76-11070# Naval Postgraduate School, Monterey, Calif
FUEL CELL PRESSURE LOADING DURING HYDRAULIC RAM M.S Thesis
John W Patterson Jun 1975 62 p refs
(AD-A012411) Avail NTIS CSCL 01/3
Hydraulic ram is the phenomenon associated with the damage caused by high speed projectile impacts with fuel tanks It is divided into five phases, entry, shock drag cavity and exit The entry, shock and drag phases were of concern in this study An analytical solution for the pressures developed in the shock phase was formulated based on bullet impact parameters Pressures developed in the drag phase were experimentally correlated with theoretical predictions These pressures were proven to be dependent on front wall wave reflections GRA

N76-11077+ Engineering Sciences Data Unit London (England)
ESTIMATION OF CRUISE RANGE PROPELLER-DRIVEN AIRCRAFT
Aug 1975 18 p refs Sponsored by Roy Aeronautical Soc
(ESDU-75018) Copyright Avail NTIS HC $146 50
Methods for estimating the cruise air range of propeller-driven aircraft were given Expressions were also given for the fuel flow consumption, specific air range and endurance Piston-engined and turbo-prop engined aircraft were discussed Author

N76-11078*# Lockheed-Georgia Co, Marietta
HIGH REYNOLDS NUMBER TESTS OF A C-141A AIRCRAFT SEMISPAN MODEL TO INVESTIGATE SHOCK-INDUCED SEPARATION
W T Blackerby and J F Cahill Washington NASA Oct 1975 193 p refs
(Contract NAS2-8269)
(NASA-CR-2604) Avail NTIS HC $7 50 CSCL 01C
Results from a high Reynolds number transonic wind tunnel investigation are presented Wing chordwise pressure distributions were measured over a matrix of Mach numbers and angles-of-attack for which shock-induced separations are known to exist The range of Reynolds number covered by these data nearly spanned the gap between previously available wind tunnel and flight test data The results are compared with both flight and low Reynolds number data, and show that use of the semispan test technique produced good correlation with the prior data at both ends of the Reynolds number range, but indicated strong sensitivity to details of the test setup Author

N76-11079*# National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
DESIGN, COST, AND ADVANCED TECHNOLOGY APPLICATIONS FOR A MILITARY TRAINER AIRCRAFT
Gary C Hill and Michael Harper Aug 1975 36 p refs
(NASA-TM-X-62469) Avail NTIS HC $4 00 CSCL 01C
The potential impact is examined of advanced aerodynamic and propulsive technologies in terms of operating and acquisition costs on conceptual mission and performance requirements for a future undergraduate jet pilot trainer aircraft Author

N76-11080# Eidgenossisches Flugzeugwerk Emmen (Switzerland)
DESCRIPTION OF THE POSSIBILITY TO UTILIZE A ROTATING CYLINDER AS MOUSTACHE
M Martinaglia 9 Jan 1973 30 p In GERMAN
(CH-6032-Emmen FO-1153) Avail NTIS HC $3 75
A high lift airfoil for the fuselage nose of the Mirage 3 S is developed that reduces starting- and landing-runs This extra airfoil increases lift by increasing the angle of attack, it is kept relatively small for retraction at high flight velocities A rotational cyclinder (Magnus effect) is investigated as an alternative to the Moustache effect because of its high C sub A value
Transl by G G

N76-11081# European Space Agency, Paris (France)
CONTROL CONFIGURED VEHICLES (CCV)
May 1975 128 p refs Transl into ENGLISH of "Regler-Gestuetzte Flugzeuge (CCV)" DGLR, Cologne Report DLR-Mitt-74-11, 1974 128 p Proc of Joint Meeting of DGLR Specialist Comm 'Flight Characteristics' and "Flight Control', Hamburg, 18 Oct 1973 Original German report available from ZLDI, Munich 26 90 DM
(ESA-TT-164, DLR-Mitt-74-11) Avail NTIS HC $6 00

Requirements and possible solutions for control configured vehicles (CCV) are discussed A review is given of control technology problems associated with CCV design, and research is reported on two specimen aircraft with regard to artificial stabilization Requirements for maneuverability and dynamic behavior in longitudinal motion were established A design for a damper-stabilizer system in an aircraft with an elastic elevator system was investigated for different suboptimal control unit structures with limited recovery capacity

N76-11082 Messerschmitt-Boelkow-Blohm G m b H , Ottobrunn (West Germany)
CONTROL TECHNOLOGY ASPECTS OF AIRCRAFT WITH ARTIFICIAL STABILITY (CCV) WITH PARTICULAR RESPECT TO HANDLING UNDER MANEUVER LOADING
Wolfgang Kubbat *In* ESA Control Configured Vehicles (CCV) (ESA-TT-164) May 1975 p 7-32 Transl into ENGLISH from "Regler-gestuetzte Flugzeuge (CCV)' DGLR Cologne Report DLR-Mitt-74-11, 1974 26 p

Control technology problems with the control configured vehicle (CCV) are reviewed The proposals discussed include control of unstable aircraft control of maneuver loading, reduction of gusting flutter damping, and control valves In connection with the problem of gusting reduction/maneuver loading control, it is shown that the solution cannot be treated in isolation, and the concept of an integrated total control of the elastic aircraft is deduced This exercise includes both the control of rigid structural forms (the prevailing task) and the addition of forms of elastic movement Results are presented for two illustrative aircraft The growing difficulty of the complexity of signal gain and processing is discussed Author (ESA)

N76-11083 Messerschmitt-Boelkow-Blohm G m b H , Hamburg (West Germany)
PARAMETRIC INVESTIGATION OF LONGITUDINAL MOVEMENT OF CCV TRANSPORT AIRCRAFT
Heiko Anders *In* ESA Control Configured Vehicles (CCV) (ESA-TT-164) May 1975 p 57-75 Transl into ENGLISH from "Regler-gestuetzte Flugzeuge (CCV) , DGLR Cologne Report DLR-Mitt-74-11 1974 19 p

Making use of two specimen aircraft (the A-300 B and the CON 30 STOL transport project design), research into the artificial stabilization of these aircraft was carried out Requirements for maneuverability and dynamic behavior in longitudinal movement were established These served for control system design and for definition of critical boundaries Also investigated were the effects of different parameters on the critical boundaries to establish trends for future design work The specimen aircraft were used to demonstrate how much can be achieved in additional performance by artificial stabilization (useful load, range) It was established that in the transport aircraft investigated a renunciation of natural stability can lead to an improvement in cost-effectiveness Author (ESA)

N76-11084 Bodenseewerk Geraetetechnik G m b H Ueberlingen (West Germany)
FUNDAMENTAL RESEARCH INTO THE OPTIMAL DESIGN OF A DAMPER-STABILIZER SYSTEM WITH AN ELASTIC ELEVATOR
Gunther Schaenzer *In* ESA Control Configured Vehicles (CCV) (ESA-TT-164) May 1975 p 104-128 refs Transl into ENGLISH from "Regler-gestuetzte Flugzeuge (CCV) DGLR, Cologne Report DLR-Mitt-74-11, 1974 25 p

The design of a damper-stabilizer system in an aircraft with an elastic elevator system was investigated for different sub-optimal control unit structures with limited recovery capacity Probing vertical gusting was used as the exciting factor Pitch angle speed, flight path speed error, and elevator activity were all taken into consideration in the quadratic quality index Contrary to expectation, the additional return action of the two elevator variables produces only minor improvement of control quality Considerable improvements in control quality are achieved via the strong recovery action of the elevator servo-motor sweep speed The optimal equivalent damping level for the elevator servo-motor amounts to about D = 8 in the specimen aircraft and leads to good control characteristics In all the control unit structures investigated, the elastic elevator brings a deterioration of control quality by comparison with the rigid elevator Author (ESA)

N76-11085# Air Force Flight Dynamics Lab , Wright-Patterson AFB Ohio
AIRCRAFT GOUND TEST VALIDATION OF A VARIABLE-RESPONSE LANDING GEAR CONCEPT Final Report, Aug 1973 - Aug 1974
Joseph G Mercer Mar 1975 65 p refs
(AF Proj 1369)
(AD-A011657 AFFDL-TR-74-143) Avail NTIS CSCL 01/3

Taxi tests involving an A-37B aircraft were performed at Wichita Municipal Airport, Kansas The main landing gear was modified to minimize strut friction and to incorporate a softer pneumatic spring It was found that elimination of strut friction alone or elimination of strut friction combined with the use of a softer pneumatic spring could significantly reduce aircraft wing stresses For the cantilever type strut tested, it was determined that reduction of strut friction should be the primary target in attempting to reduce the transmission of ground loads to the airframe These tests also verified the ability to test trends in landing gear load transmission characteristics using a landing gear drop tower and a hydraulic vibration machine GRA

N76-11086# Teledyne Ryan Aeronautical Co , San Diego, Calif
COMPOSITE MANEUVER AUGMENTATION (COMMA) FOR FIGHTER AIRCRAFT PRELIMINARY DESIGN STUDY
Robert B Chisman Jan 1974 311 p refs
(Contract F33657-73-A-0056-0005)
(AD-A011772 TRA-30120-1 AFFDL-TR-73-143) Avail NTIS CSCL 01/3

The Air Force Flight Dynamics Laboratory plans to test an advanced composite wing with an internally blown jet flap on a low cost, low risk unmanned vehicle This technical report identifies required modifications to the BQM-34F target vehicle, including the engine and wing interface constraints, to support the flight test program Emphasis was given to the fuselage structure elevator control power, bleed air valve and ducting, flight control system, vehicle electrical system and the instrumentation and telemetry systems AFFDL provided the wing definition and jet flap wind tunnel test data GRA

N76-11087# Goodyear Aerospace Corp , Litchfield Park, Ariz
WINDOW CONTOURED GLASS/PLASTIC TRANSPARENT ARMOR FOR THE UH-1D HELICOPTER Final Report, 4 Jan 1973 - 20 Jan 1975
Wilson C McDonald and Richard A Huyett May 1975 82 p
(Contract DAAG46-73-C-0075)
(AD-A012215 GERA-2074, AMMRC-CTR-75-12) Avail NTIS CSCL 01/3

The objectives of this program relate to the design of a transparent armor installation for the UH-1D helicopter This effort incorporated for the first time significant amounts of high performance glass/plastic laminate armor in an aircraft Eight slipsets of armor were produced one of which was installed and flight tested Environmental testing was also conducted to define armor performance and characteristics GRA

N76-11088# Advanced Technology Center, Inc, Dallas, Tex
DESIGN STUDIES OF TRANSONIC AND STOL AIRFOILS WITH ACTIVE DIFFUSION CONTROL Final Report, 19 Apr 1973 - 19 Jun. 1974
C H Haight, T D Reed, and B T Morland 19 Jun 1974 88 p refs
(Contract N00019-73-C-0426)
(AD-A011928, ATC-B-94300/4CR-24) Avail NTIS CSCL 01/3

Results of parametric design studies are presented for supercritical airfoils which employ active diffusion control Efforts were concentrated on two basically different airfoil profiles One type of airfoil has a 6% thickness to chord ratio and employs an antiseparation tailored contour (ATC) located in the forward lower surface This type of airfoil is considered to be a promising candidate for improving the transonic performance of combat aircraft The second type of airfoil is 12% thick and has an ATC within the aft, upper surface This type of wing section is applicable to transonic transports and is compatible with previous STOL designs which employ ATC's Theoretical analyses indicate both airfoils have large values of the transonic cruise parameter, good transonic lift characteristics, and, in general, offer improved transonic performance GRA

N76-11089# United Aircraft Corp, Stratford, Conn Sikorsky Aircraft Div
HELICOPTER MAINTENANCE EFFECTIVENESS ANALYSIS Final Report
Calvin Holbert and Gary Newport May 1975 131 p
(Contract DAAJ02-73-C-0029, DA Proj 1F1-62205-A-119)
(AD-A012225, USAAMRDL-TR-75-14) Avail NTIS CSCL 01/3

A study has been made of U S Army maintenance operations to determine the significance of repetitive maintenance and incorrect diagnoses in regard to U S Army maintenance efficiency A questionnaire was distributed to Army maintenance personnel to solicit their views on maintenance efficiency In addition, Army aircraft inspection and maintenance data (DA Form 2408-13 and Operations Reliability Maintainability Engineering Data) were reviewed to quantify the number of repetitive maintenance actions These data included maintenance personnel and maintenance actions for the UH-1H, Ch-47C, and CH-54B model helicopters GRA

N76-11090# Raven Industries Inc, Sioux Falls, S Dak
POBAL-S, THE ANALYSIS AND DESIGN OF A HIGH ALTITUDE AIRSHIP Final Report, Oct. 1972 - Mar 1975
Jack D Beemer, Roger R Parsons Loren L Rueter Paul A Seuferer and LaDell R Swiden 15 Feb 1975 183 p refs
(Contract F19628-73-C-0076, AF Proj 6665 AF Proj 6866)
(AD-A012292, R-0275006, AFCRL-TR-75-0120) Avail NTIS CSCL 01/3

An engineering analysis and development effort has been executed to design a superpressure airship, POBAL-S, capable of station keeping at an altitude of 21 kilometers for a duration of 7 days while supporting a payload weighing 890 newtons and requiring 500 watts of electrical power A detailed parametric trade-off between various power sources and other design choices was performed The computer program used to accomplish this analysis is described and many results are presented Th system concept which resulted was a fuel cell powered, propeller driven airship controlled by an on-board autopilot with basic commands telemetered from a ground control station Design of the balloon power train, gimbaled propeller assembly and electronic/electrical systems is presented Flight operations for launch and recovery are discussed GRA

N76-11091# Naval Intelligence Support Center, Washington, D C Translation Div
THE SORMOVICH EXPERIMENTAL AIR CUSHION VEHICLE
A Zhivotovskii V Shenberg and A Minchenya 28 May 1975 7 p Transl into ENGLISH from Rechn Transp (USSR), no 3, 1973 p 53-54
(AD-A012080 NISC-Trans-3677) Avail NTIS CSCL 13/10

The subject experimental air cushion passenger vehicle is an amphibious craft with a nozzle system for forming the air cushion a flexible skirt, and location of the engine room, fan and air propellers in the stern and delivery of power to all users from a single engine through a system of gears and shafts GRA

N76-11092# Lockheed-Georgia Co Marietta
EVALUATION OF THE FLYING QUALITIES REQUIREMENTS OF MIL-F-8785B ASG USING THE C-5A AIRPLANE Final Report, Sep 1974 - Mar 1975
Charles C Silvers and Clifton C Withers 20 Mar 1975 335 p
(Contract F33615-75-C-3012)
(AD-A011728 AFFDL-TR-75-3) Avail NTIS CSCL 01/2

The study was conducted to validate military specification MIL-F-8785B(ASG), Flying Qualities of Piloted Airplanes, dated 7 August 1969 Interim Amendment-1 (USAF), dated 31 March 1971 by performing a detail comparison of its requirements with the known characteristics of the Lockheed C-5A and pilot comments on them The comparison was based primarily on existing flight test data supplemented by analytical data as required for this evaluation process Paragraph by paragraph validations of discrepancies are noted, resolution attempted if necessary, and any recommendations given In addition, recommendations are made enumerating experimental and analytical investigations beyond the scope of this study which will provide data for further validation and updating of the requirements GRA

N76-11093# Bell Helicopter Co, Fort Worth Tex
AN INVESTIGATION OF HIGH-G MANEUVERS OF THE AH-1G HELICOPTER
James R VanGaasbeek Apr 1975 179 p refs
(Contract DAAJ02-73-C-0092, DA Proj 1F1-62208-AA-43)
(AD-A012234 USAAMRDL-TR-75-18) Avail NTIS CSCL 01/2

The high-g maneuver capabilities of the AH-1G have been investigated in this effort Flight test data for 132 high-g maneuvers have been studied and statistically analyzed to determine the relationships among the variables A series of fixed-collective symmetric pullups was simulated, using the Rotorcraft Flight Simulation Program C81 to determine the mechanisms limiting high-g maneuvers of the AH-1G Statistical analysis of the C81 data was used to supplement the analysis of the test data Three additional maneuvers, similar to the most severe test maneuvers were simulated GRA

N76-11094# Boeing Vertol Co Philadelphia, Pa
ENGINE/TRANSMISSION/AIRFRAME ADVANCED INTEGRATION TECHNIQUES Final Technical Report
Theodore Himka and Richard D Semple May 1975 172 p refs
(Contract DAAJ02-74-C-0043, DA Proj 1G2-62207-AH-89)
(AD-A012236 D210-10900-1 USAAMRDL-TR-75-16) Avail NTIS CSCL 01/3

Innovative engine/transmission/airframe integrated design concepts were developed to provide total airflow and power management for a utility transport helicopter which meets projected requirements of future Army aircraft These requirements include engine compartment cooling, drive train and transmission oil cooling, engine oil cooling, exhaust plume and hot metal infrared (IR) signature suppression and engine inlet foreign particle protection GRA

N76-11095# Hughes Helicopters Culver City Calif
PRODUCIBILITY AND SERVICEABILITY OF KEVLAR-49 STRUCTURES MADE ON HOT LAYUP TOOLS Final Report, 31 May 1974 - 30 Apr 1975
B Head J Leach, R Goodall and C Sitterly May 1975 114 p refs
(Contract DAAG46-74-C-0100)
(AD-A012265, AMMRC-CTR-75-10) Avail NTIS CSCL 11/4
The purposes of the program were evaluate the producibility of a helicopter structural component made from Kevlar-49 fibers, demonstrate the low cost aspects of using hot layup tools to fabricate composite structures, and evaluate the serviceability of the Kevlar-49 structure in actual field operations GRA

N76-11097*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
DUCT LINER OPTIMIZATION FOR TURBOMACHINERY NOISE SOURCES
Harold C Lester and Joe W Posey Nov 1975 20 p refs Presented at 90th Meeting of the Acoust Soc of Am, San Francisco, 4-7 Nov 1975
(NASA-TM-X-72789) Avail NTIS HC $3 50 CSCL 21E
An acoustical field theory for axisymmetric multisectioned lined ducts with uniform flow profiles was combined with a numerical minimization algorithm to predict optimal liner configurations having one, two, and three sections Source models studied include a point source located on the axis of the duct and rotor/outlet-stator viscous wake interaction effects for a typical research compressor operating at an axial flow Mach number of about 0 4 For this latter source, optimal liners for equipartition-of energy, zero-phase and least-attenuated-mode source variations were also calculated and compared with exact results It is found that the potential benefits of liner segmentation for the attenuation of turbomachinery noise is greater than would be predicted from point source results Furthermore, effective liner design requires precise knowledge of the circumferential and radial modal distributions Author

N76-11098*# Solar San Diego, Calif
ADVANCED LOW NO SUB x COMBUSTORS FOR SUPERSONIC HIGH-ALTITUDE AIRCRAFT GAS TURBINES Report for Mar 1974 - Jun 1975
P B Roberts, D J White, and J R Shekleton Nov 1975 81 p refs
(Contract NAS3-18028)
(NASA-CR-134889 RDR-1814) Avail NTIS HC $5 00 CSCL 21E
A test rig program was conducted with the objective of evaluating and minimizing the exhaust emissions, in particular NO sub x of three advanced aircraft combustor concepts at a simulated, high altitude cruise condition The three combustor designs, all members of the lean reaction premixed family, are the Jet Induced Circulation (JIC) combustor, the Vortex Air Blast (VAB) combustor, and a catalytic combustor They were rig tested in the form of reverse flow can combustors in the 0 127 m (5 0 in) size range Various configuration modifications were applied to each of the initial JIC and VAB combustor model designs in an effort to reduce the emissions levels The VAB combustor demonstrated a NO sub x level of 1 1 gm NO2/kg fuel with essentially 100% combustion efficiency at the simulated cruise combustor condition of 50 7 N/sq cm (5 atm), 833 K (1500 R) inlet pressure and temperature respectively and 1778 K (3200 R) outlet temperature on Jet-A1 fuel Early tests on the catalytic combustor were unsuccessful due to a catalyst deposition problem and were discontinued in favor of the JIC and VAB tests In addition emissions data were obtained on the JIC and VAB combustors at low combustor inlet pressure and temperatures that indicate the potential performance at engine off-design conditions Author

N76-11099*# Naval Air Propulsion Test Center, Trenton, NJ
ROTOR BURST PROTECTION PROGRAM STATISTICS ON AIRCRAFT GAS TURBINE ENGINE ROTOR FAILURES THAT OCCURRED IN US COMMERCIAL AVIATION DURING 1973 Final Report, 1972 - 1973
R A DeLucia and G J Mangano Aug 1975 28 p
(NASA Order C-41581-B)
(NASA-CR-134854 NAPTC-PE-61) Avail NTIS HC$3 75 CSCL 21E
Statistical data on gas turbine rotor failures that have occurred in U S commercial aviation during 1973 was presented Analysis of the data led to the following conclusions (1) the incidence of rotor failure and uncontained burst is significantly high enough to warrant continuation of the efforts of the Rotor Burst Protection Program (RBPP), (2) of all the types of fragments generated, disk fragments because of their size, high energy content and high rate of uncontainment (100 %), continue to be a major threat to the welfare and safety of commercial aircraft passengers, (3) the number of uncontained blade failures is surprisingly high since rotor blade containment is required for engine certification under FAA regulations, (4) it appears that causes beyond the control or scope of pressent technology are still primarily responsible for most of the rotor failures that occur YJA

N76-11100*# Transemantics, Inc, Washington, D C
THE PROBLEM OF FLOW MIXING IN A DOUBLE-FLOW ENGINE
Barbara Jung Washington NASA Nov 1975 20 p refs Transl into ENGLISH from Technika Lotnicza i Astronautyczna (Poland) v 22 Aug 1967 p 5-10
(Contract NASw-2792)
(NASA-TT-F-16648) Avail NTIS HC $3 50 CSCL 21E
The problem of mixing gas flow from the main channel and air flow from the outer channel of a double-flow engine was discussed Methods of designing the mixing chambers to achieve a constant cross-section and a constant pressure in the range of subsonic velocities for both flows were presented, and the usefulness of flow mixing was justified Some typical construction designs for mixing chambers were described Author

N76-11103# Southwest Research Inst San Antonio, Tex
DEVELOPMENT OF A ROTATING CYLINDER DEPOSITION TEST Interim Report, 1 Feb 1972 - 31 Mar 1975
J P Cuellar and B B Baber Jun 1975 65 p refs
(Contract F33615-72-C-1097, AF Proj 3048)
(AD-A012298, SwRI-RS-629, AFAPL-TR-75-37) Avail NTIS CSCL 11/8
A rotating cylinder deposition test for the evaluation of aircraft turbine engine lubricants was investigated The device was selected for study on the basis of its promise for achieving controlled or measurable lubricant films and oxidative exposure conditions Evaluation tests with this configuration were performed with four coded lubricants Performance criteria in these tests included deposit rating, viscosity and neutralization number change, and oxygen consumption Test conditions selected for this series of runs results in severe fluid deterioration for all but one lubricant GRA

N76-11105*# National Aeronautics and Space Administration, Washington, D C
FLIGHT-DETERMINED STABILITY AND CONTROL DERIVATIVES FOR AN EXECUTIVE JET TRANSPORT
Harriet J Smith Jul 1975 46 p refs
(NASA-TM-X-56034, H-901) Avail NTIS HC $4 00 CSCL 01C
A modified maximum likelihood estimation (MMLE) technique which included a provision for including a priori information about unknown parameters was used to determine the aerodynamic derivatives of the Lockheed JetStar airplane Two hundred sixty-five maneuvers were performed with the JetStar airplane, which was modified to include direct lift controls to obtain lateral-directional and longitudinal derivatives Data were obtained at altitudes of 3048 meters 6096 meters, and 9144 meters

(10,000 feet 20,000 feet and 30,000 feet) and over an angle of attack range from approximately 3 deg to 13 deg and a Mach number range from 0 25 to 0 75 Side force generators were installed and tested in 87 maneuvers to determine their effectiveness and their effect on the other derivatives Lateral-directional data for four flight conditions were analyzed without using a priori information to assess the effect of this feature on the results The MMLE method generally gave consistent (repeatable) estimates of the derivatives, with the exception of the rolling moment due to yaw rate which showed large variances Author

N76-11106# Honeywell, Inc, Minneapolis, Minn Government and Aeronautical Products Div
DEVELOPMENT OF A HYDROFLUIDIC STABILIZATION AUGMENTATION SYSTEM HYSAS FOR AN AX CLASS AIRCRAFT Final Report, Dec 1972 - Nov 1974
Holger C Kent Jan 1975 177 p
(Contract F33615-73-C-3068)
(AD-A011727, Honeywell-W-3068, AFFDL-TR-74-147) Avail NTIS CSCL 01/3

This program consisted of the design, development, fabrication and evaluation of a Hydrofluidic Yaw Axis Stability Augmentation System (HYSAS) The objective was to develop a low cost reliable lightweight, flightworthy HYSAS with moderate performance and low-field maintenance characteristics compared to an electro-hydraulic SAS for jet powered AX class tactical aircraft A system analysis was conducted that included a computer simulation of the Fairchild Aircraft Co A-10 aircraft From the results of the computer simulation, a yaw damper configuration was determined that improved flying quality characteristics by increasing dutch roll damping throughout the flight envelope of the AX Class Tactical Aircraft (AXCTA) GRA

N76-11107# Bell Helicopter Co Fort Worth, Tex
FLIGHT CONTROL SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATIONS Final Report
John Zipperer, Gavin Jenney, and Jerry Bryant Mar 1975 294 p refs
(Contract DAAJ02-73-C-0026, DA Proj 1F1-62203-A-119)
(AD-A012233, USAAMRDL-TR-74-57-FR) Avail NTIS CSCL 01/3

Army helicopter nonrotating flight control system specifications standards and design handbooks were reviewed for areas in which improvements could be made to requirements affecting system and mission reliability and maintainability R and M requirements were essentially missing from all documents reviewed and therefore specific requirements were added for reliability, maintainability, and supporting workmanship qualification and production acceptance Special emphasis was directed toward requiring those distributional material properties, failure and maintenance time data and analytical methods which permit Design for Reliability (Probabilistic Design) and Maintainability directly into components and thus into the flight control system GRA

N76-11179* National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston, Tex
FIRE-RESISTANT AIRCRAFT MATERIALS DEVELOPMENT AND EVALUATION PROGRAM
Richard W Bricker and Robert N Stuckey *In its* 8th Conf on Space Simulation 1975 p 833-854 refs

(Paper-70) CSCL 14B

An aircraft flammability program was undertaken to utilize spacecraft developed fire-resistant materials to improve passenger safety and decrease losses from unattended fires in commercial aircraft Five full-scale aircraft flammability tests were performed to evaluate the effectiveness of improved fire-resistant materials by comparing their burning characteristics with those of pre-1968 aircraft materials Author

N76-11257# Boeing Aerospace Co, Seattle Wash Research and Engineering Div
EVALUATION OF REINFORCED THERMOPLASTIC COMPOSITES AND ADHESIVES Final Report, 1 Apr 1974 - 1 Feb 1975
J T Hoggatt and A D VonVolkli Mar 1975 100 p refs
(Contract N00019-74-C-0226)
(AD-A011407 D180-17503-3) Avail NTIS CSCL 11/4

Kevlar-49 fabric laminates with polysulfone resin matrix were evaluated for mechanical and electrical properties and environmental resistance to explore its potential for secondary and primary aircraft structure Investigations indicated Kevlar-49 reinforced thermoplastic laminates in general exhibited properties equivalent to laminates made with thermosetting matrices Thermoplastic polymers with service temperatures in excess of +300 F were screened with three polymers being subjected to in-depth study These polymers were 200P polysulfone (+325 F service) 720P polysulfone (+400 F service) and NR150A polyimide (+450 F service) Each material exhibited good property translation and thermal stability within the stated service temperature range Processing conditions for the polymers were within the limitations of most commercial autoclaves Polysulfone resin was evaluated as an adhesive and exhibited excellent adhesive properties for bonding stainless steel and composites Values in excess of 4500 psi and 3400 psi were obtained at 70 F and +250 F, respectively, on stainless steel lap bond specimens Composite-to-composite bonds produced values in excess of 8000 psi with a polysulfone adhesive GRA

N76-11292# Ministry of Defence London (England)
THE EVALUATION OF VHR 2A AND VHR 3A GLASSES (GLAVERBEL-MECANIVER S A) FOR AEROSPACE APPLICATIONS
N S Corney Mar 1975 32 p refs
(BR44083 DR-Mat-198) Avail NTIS HC $4 00

The mechanical properties of two glasses for aircraft transparencies were evaluated using beam specimens of 2mm thickness The products are shown to be of reproducible quality with modulus of rupture 247 MPa (standard deviation 11 MPa) for VHR 2A and 233 MPa (standard deviation 7 MPa) for VHR 3A The effects of a standard sand abrasion at two levels of severity were investigated Some thermal ageing experiments were carried out on both glasses in the unloaded condition Sustained loading experiments for 3000h at 60% of the modulus of rupture in the as-received (or appropriately abraded condition) were carried out and indicated no significant effect of sustained loading on modulus of rupture Likewise cyclic loading experiments on the as-received glasses for 2000h at a cycle of 3h on load (at a value of 30% of the initial modulus of rupture) 0 5h off load, caused no degradation of the modulus of rupture Climatic weathering tests on these glasses are in progress and the results to date show no deterioration of the modulus of rupture after 1 year exposure in the unloaded condition It is shown that both VHR2A and VHR3A glasses of 2mm thickness have properties entirely suitable for certain aircraft applications e g as facing glasses for structural plies of plastic materials or as laminating piles for low speed aircraft Because of the improved resistance of the VHR3A glass at the more severe level of abrasion this glass might be preferred in particular applications Author (ESA)

N76-11317# Mar, Inc, Rockville Md
FEASIBILITY STUDY OF HELICOPTER-TOWED AIR CUSHION LOGISTIC VEHICLES Final Report, 31 Mar - 30 Jun 1975
V F Neradka J C Stevens and R L Levin Jun 1975 67 p refs
(Contract N00014-73-C-0178)
(AD-A011803, TR-148) Avail NTIS CSCL 13/10

A feasibility study of a helicopter-towed air cushion logistic vehicle (ACLV) was performed The scope of the study encompassed movement of loaded LASH system lighters on unmanned air-cushion platforms from an off-shore ship onto a sand beach in support of amphibious assault operations Motive power is to be provided by towing with RH-53 helicopter Color illustrations reproduced in black and white GRA

N76-11396# Massachusetts Inst of Tech, Cambridge Fluid Dynamics Research Lab
ON THE DEVELOPMENT OF A UNIFIED THEORY FOR VORTEX FLOW PHENOMENA FOR AERONAUTICAL APPLICATIONS Technical Report, 1 Nov 1973 - 31 Oct 1974
Thomas K Matoi 14 Apr 1975 145 p refs
(Contract N00014-67-A-0204-0085, NR Proj 215-230)
(AD-A012399) Avail NTIS CSCL 20/4

The low-speed performance of a high span loading aircraft depends critically on the structure and stability of the vortex flow field created by the wing Conventional formulation of lifting surface theory is not adequate to handle the low-aspect-ratio wing problem since the leading edge vortices add several complications Specifically the nonplanar nature of the vortex sheet may have to be considered explicitly, the leading-edge loading is altered, and vortex breakdown is a rotational phenomenon Due to those additional difficulties, a study was made of the state of the art in vortex-wing interactions GRA

N76-11440# Technische Hochschule Vienna (Austria)
ACTUAL DESIGN CRITERIA IN MECHANICAL ENGINEERING
Franz Mueller-Magyari and Walter Sperr 1975 7 p refs In GERMAN ENGLISH summary
(ICAF-Doc-794) Avail NTIS HC $3 50

Some methods by which the determination of the fatigue life of aircraft components can be performed were discussed Two of these the Safe Life and the Fail Safe approaches are the basis for numerous studies in fatigue analysis and fracture mechanics In this case the crack length in a component is introduced as a measure of damage and the crack propagation rate as a criterion for the fatigue life The objectives are an analysis of the local stress distribution in the cracked area and the question of damage accumulation The empirical (program tests) and the analytical evaluation of damage accumulation (accumulation hypothesis) were discussed The basis of such studies are evaluations of load-time histories and the correlation of load input and dynamic response data A very recent item of engineering design, the transition from allowable-stress design to fatigue life prediction criteria, was also discussed Author

N76-11448# McDonnell Aircraft Co, St Louis, Mo
RELIABILITY OF STEP-LAP BONDED JOINTS Final Report
E B Birchfield R T Cole and L F Impellizzeri Apr 1975 177 p refs
(Contract F33615-74-C-3015, AF Proj 4364)
(AD-A012009, AFFDL-TR-75-26) Avail NTIS CSCL 13/5

The objective of the program was an improved technology base of data and methods applicable to the efficient design of graphite-epoxy to titanium step-lap-bonded airframe joints that are optimized for reliability under military flight loading A random spectrum was used in repeated load tests to establish a data base for defining lifetime and residual strength characteristics Static strength tests were also conducted which show good comparison with prediction of an elastic-plastic analysis procedure The static strength, residual strength and lifetime data were assumed to be from Weibull distributions The shape and scale parameters for each of these distributions were calculated using the best linear unbiased (BLU) estimation procedure Using these procedures wearout models were calibrated and checked and conclusions concerning scaling, and translation of parameters were drawn Tests were also conducted to determine the effect upon lifetime of load truncation load frequency, relaxation time between missions, and temperature GRA

N76-11456# Technische Hochschule Vienna (Austria)
THE FRACTURE MECHANICS APPROACH IN STRUCTURAL DESIGN
Walter R Sperr 1975 8 p refs In GERMAN, ENGLISH summary
(ICAF-Doc-795) Avail NTIS HC $3 50

The concept of fracture mechanics in structural design was discussed by distinguishing between two engineering applications (1) high-stressed thick-walled components, such as pressure vessels or turbine-rotor discs, which show relatively short critical crack lengths and plane strain conditions, and (2) thin-walled, stiffened components like aircraft shell structures In the first case, the analysis deals with methods for the prevention of brittle fracture and crack initiation difficulties may arise with the introduction of dynamic loads and corrosive effects on subcritical crack growth In the second case, subcritical crack growth under random loads and the determination of the fracture strength of the components are of main interest The advantage of a more simple theoretical approach in plane stress conditions is opposed by the necessity to introduce the influence of a large plastic zone at the crack tip Practical applications of these concepts are given Author

N76-11472# European Space Agency, Paris (France)
A NEW DEVICE FOR THE VIBRATORY EXCITATION OF MECHANICAL STRUCTURES
Jean-Francois Boisseau Sep 1975 45 p refs Transl into ENGLISH of "Un Nouveau Dispositif d'Excitation Vibratoire de Struct Mecan ONERA Paris Report ONERA-NT-223, 1974
(ESA-TT-184 ONERA-NT-223) Avail NTIS HC $4 00

Vibration generators are described which include a rotating mobile dynamically balanced element, driving a mass in a linear movement along an unlimited travel The rotation kinetic energy of the mechanism and the kinematic ratio are optimized for the required conditions (available force, expected perturbations, and mass participation in the excited structure) The proposed solutions present some interesting properties which lie between those of the reversible electrodynamic and the irreversible hydraulic generators Ground and flight test results on several models (force 40 to 450 N and travel 50 to 450 mm) were in good agreement with the calculations and known results Other applications are being considered for heavy structures excited between 0 1 and 30 Hz, in harmonic and random modes Author (ESA)

N76-11915# RAND Corp Santa Monica Calif
ESTIMATING LIFE-CYCLE COSTS A CASE STUDY OF THE A-7D
Marco Fiorello Feb 1975 65 p
(Contract F44620-73-C-0011)
(AD-A011643, R-1518-PR) Avail NTIS CSCL 15/5

The report is concerned with the determination of costs incurred in acquiring and owning a weapon system and the data problems associated therewith Incurred or historical costs can be used to anticipate future costs of operations and support, to compare forecast with incurred costs for evaluating forecasting techniques, or to estimate a weapon system s total life cycle costs (LCC) for use along with the associated weapon system capability, in force structure planning The principal objective of the study is to demonstrate the derivation of the life-cycle cost GRA

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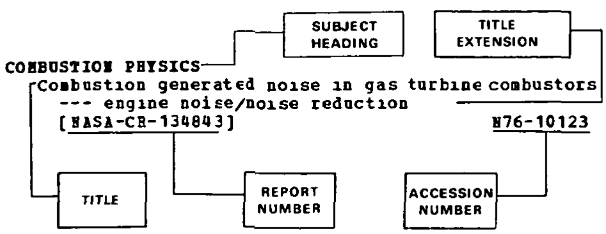

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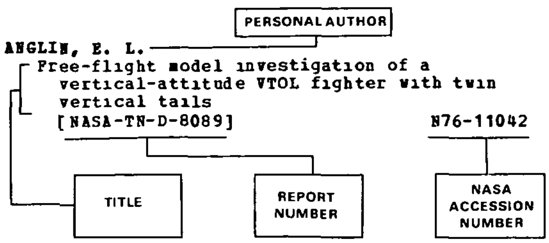

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